

GOVERNMENT OF INDIA
ARCHAEOLOGICAL SURVEY OF INDIA
CENTRAL
ARCHAEOLOGICAL
LIBRARY

ACCESSION NO. 8865

CALL No. Sa6 Vr / Ray

D.G.A. 79







Environ

100

244

4584

NIONS ON VOL. I.

I... the work is a most interesting and valuable contribution to chemistry; and exhibits an amount of clear and research which does the author the greatest credit.— *Henry E. Roscoe.*

A new and interesting chapter has been added to the history of sciences and of human progress.— *M. Berthelot.*

Dr. Ray has spared no pains to make his work a masterpiece of its kind.— *The Pioneer.*

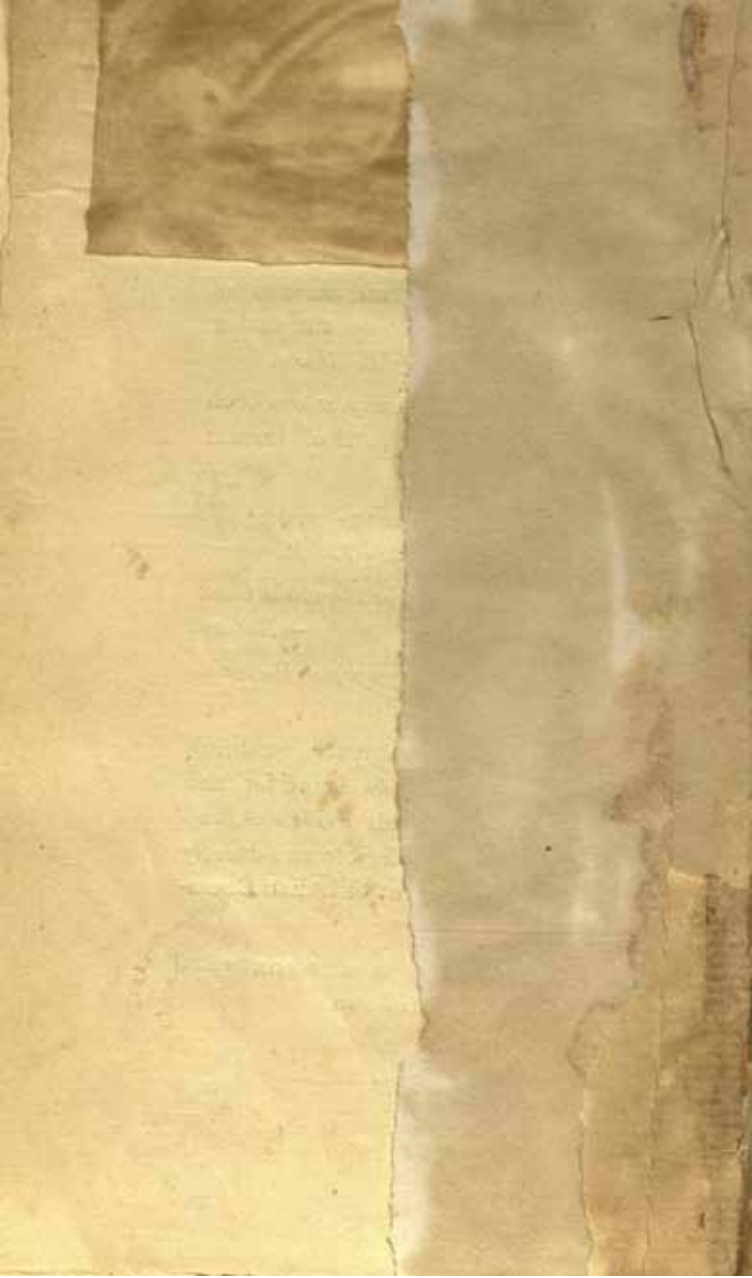
Dr. Ray has ably carried out his task.
— *Nature.*

That unusually interesting work.— *Pharmaceutical Post* (Vienna)

... one more eminently qualified in Professor Ray could be found for the ultimate task of sifting such evidences, and bringing from them an intelligible and orderly account of the development of Indian Chemistry. *The Times of India.*

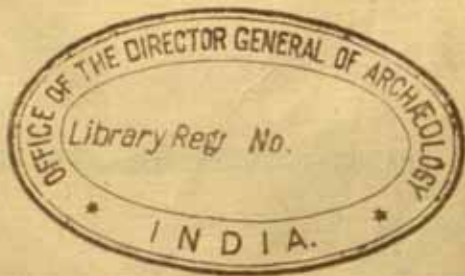
This Pioneer work is a monumental labour of love. *The Englishman.*





HISTORY OF HINDU CHEMISTRY

Vol 2



CHU



LIBRARY OF THE
MUSEUM OF NATURAL HISTORY



A
HISTORY OF HINDU CHEMISTRY

FROM

THE EARLIEST TIMES TO THE MIDDLE OF THE
SIXTEENTH CENTURY A. D.

WITH

8865

SANSKRIT TEXTS, VARIANTS, TRANSLATION
AND ILLUSTRATIONS

BY

SIR PRAPHULLA CHANDRA RAY, Kt., D. Sc., Ph. D.
Palit Prof. of Chemistry, University College of Science, Calcutta.

VOL. II

D 3026 (i)

Second Edition : Revised and Enlarged

Sa 6 Vr
Ray

Ref 540.954
Ray

CHUCKERVERTTY, CHATTERJEE & Co., Ltd.

15, College Square, Calcutta.

1925



PUBLISHED BY
R. C. CHAKRAVARTI M.Sc.
15 College Square, Calcutta.

CENTRAL ARCHAEOLOGICAL
LIBRARY, NEW DELHI.

Acc. No. 8.8.65
Date 18-7-57
Call No. Sa 6 Vn
Ray

PRINTED BY
P. C. CHAKRAVARTY
VIDYODAYA PRESS
17 Radha Nath Bose Lane, Calcutta.

To the Memory of

M. P. E. BERTHELOT

I dedicate this volume of the History
of Hindu Chemistry.



TOLENTSE 2.9.11

TOLENTSE 2.9.11

PREFACE

The second and concluding volume of the *History of Hindu Chemistry* is now presented to the public.

When the first volume was under preparation, it was feared that many valuable works on Hindu Chemistry referred to in *Rasārṇava*, *Rasaratna-samuchchaya*, *etc.*, had been lost for ever. Pandit Navakānta Kavibhūṣaṇa was deputed to Benares to make a searching enquiry and his labours have been rewarded by the discovery of several rare MSS., including one of *Rasahrīdaya*. This last-named work is of surpassing interest considering its comprehensiveness and antiquity. Two more transcripts of it have also been procured from the Libraries of the India Office, London, and of the Darbār, Nepal. A copy of *Rasendra-chūdāmaṇi* obtained from the Library of the Deccan College, Poona, has also been of signal help. A critical study of the new materials throws a flood of light on the dark recesses of the history of Indian Chemistry. As a halo of literary and scientific activity including the pursuit of alchemy circles round the prominent figure of Nāgārjuna, considerable space has been devoted to a discussion of his age in the Historical Introduction.

It was with diffidence and hesitation that I placed the remotest limit of alchemical *Tantras* in the 12th century A. D. It now transpires that this date is to be pushed back by several centuries.

A *History of Hindu Chemistry* would be rightly regarded as incomplete which did not deal with the constitution of matter and the various hypotheses in regard to it. The European historian of chemistry has always turned his eyes to Greece as the perennial fountain of knowledge on this as on other subjects. And it is but natural that he should do so. * The Hindu atomistic school has not hitherto, I am afraid, found an interpreter who could do full justice to it. Colebrooke's presentation of it with which I had to content myself in the first volume is masterly so far as it goes, but is fragmentary. Not feeling myself equal to the task I applied for help to Mr. Brajendra Náth Seal Principal, Victoria College, Cooch Behar. Principal Seal has kindly responded to my appeal with alacrity. It is to be hoped that a long-felt *desideratum* has at last been supplied.

The frequent references which have been made to the first volume must be taken to mean the second edition of it. Those who happen to possess copies of the first edition will not, however, be put to any serious inconvenience.

* *Vide* Vol. I. Intro. xliii.

I avail myself of this opportunity to express my cordial thanks to Pandit Harischandra Kavi-ratna late Professor of Sanskrit, Presidency College, and my collaborator in the editing of the text of Rasārṇava in the *Bibliotheca Indica* series.

In the preface to the first volume I presumed to narrate the circumstances under which I undertook the composition of my History. The great chemist and savant, whose inspiration has been my guiding principle throughout the arduous task and whose lengthy and appreciative review of the first instalment has been a stimulus in the continuation of it is no more. Marcellin Berthelot breathed his last on March 18, 1907, leaving the world of science poor indeed. It was with the view of coming into personal contact with the illustrious scientist that the author made a pilgrimage to Paris in March, 1905. The long interview which he had with M. Berthelot and the reception which was accorded to him at a meeting of the Academy of Sciences by its late Perpetual Secretary, as also by its President M. Troost, made a deep and lasting impression on his mind.

Alas, for the vanity of human wishes ! These pages will no longer be greeted by the eager and indulgent eyes of M. Berthelot. All that now remains for me is to dedicate this volume to his sacred memory.

It is with mingled feelings that I mark the hour of my final deliverance from a self-imposed task which has occupied all my spare time during the last 15 years and more—feelings not unlike those which overpowered the Historian of the Roman Empire. The reader will, I hope, forgive me if I venture to give expression to them in the words of Edmund Gibbon himself. "I will not dissemble the first emotions of joy on the recovery of my freedom. * * * But my pride was soon humbled, and a sober melancholy was spread over my mind, by the idea that I had taken an everlasting leave of an old and agreeable companion."

The Hindu nation with its glorious past and vast latent potentialities may yet look forward to a still more glorious future, and, if the perusal of these pages will have the effect of stimulating my countrymen to strive for regaining their old position in the intellectual hierarchy of nations, I shall not have laboured in vain.

PRESIDENCY COLLEGE

P. C. RAY.

June 1, 1909.

PRELIMINARY REMARKS ON THE
MECHANICAL, PHYSICAL AND
CHEMICAL THEORIES OF
THE ANCIENT HINDUS.

My paper on the *Mechanical, Physical and Chemical Theories of the Ancient Hindus* is intended to be a synoptic view of the entire field of Hindu Physico-chemical Science, so far as this reached the stage of positive Science as distinguished from the prior mythological and empirical stages. As the work in which my paper appears relates to Hindu Chemistry, I have elaborated the chemical portions, including the Hindu account of the constitution of the fats and oils and the organic tissues in addition to Hindu inorganic chemistry. I have also briefly noticed the chief chemical industries of the Hindus which secured them an easy pre-eminence in manufactures for a thousand years, and, in the *Addenda*, given some interesting recipes relating to several matters of chemical technology. Of mechanico-physical theories, I have expounded the Hindu conception of Energy, potential as well as kinetic, and of molecular motion, so far as they are applied to the elucidation of problems of a physico-chemical nature, viz., the constitution of

PREFACE

matter, the genesis of atoms and their infra-atomic constituents, and the chain of mechanical causation in the system of Nature. I have also touched on the Hindu theories of light, heat and sound, as implying current or wave motion, leaving the elaborate exposition to my paper on Hindu Mechanics and Physics. In the *Appendix*, I have added a brief account of the Scientific Method of the Hindus, which shows that all this was not a mass of unverified and unverifiable speculation (the very antipodes of science),—the charge usually brought against Hindu thought and culture,—but professed to be the outcome of a Scientific Methodology which, in its formulation of the canons of the two fundamental Inductive Methods, is more comprehensive as well as more original and suggestive than Mill, and which, as regards its Applied Logic of the Sciences, (*e.g.* the Logic of Therapeutics, of Grammar *etc.*), is a standing testimony to the systematic completeness and rigour of the Hindu scientific mind. The difficulties of my task have been formidable, but I have not written one line which is not supported by the clearest and most authoritative texts. The ground trodden is, for the most part, absolutely new. I have gone back to the *origines*, and studied the authorities at first hand, being resolved to eschew all second-hand sources of information. Fortunately the Sanskrit philosophico scientific terminology,

however difficult from its technical character, is exceedingly precise, consistent and expressive. The materials also are full and the sources of information corroborate one another. Another difficulty I have sought to guard myself against is the unscientific, unhistorical but very common and almost inevitable habit of reading modern ideas into old guesses or speculations of a happy-go-lucky or nebulous character. I do not think that the mere passion for Truth is a sufficient safeguard against this fatal facility of unconscious distortion or misrepresentation. A true historical perspective can only be acquired by historico-comparative studies, with the application of the correct historico-comparative method (*vide* the Introduction to my Comparative Studies in Vaishnavism and Christianity). I have also practised, or tried to practise, a habitual understatement, without consciously falling into that '*suppressio veri*' which is so often a '*suggestio falsi*.' How far I have succeeded in exhibiting the truth about Hindu science or the Hindu scientific mind is a question which I leave to competent judges to answer.

Before concluding, I must advert to my use of the terms "isomeric" and "polymeric" in senses different from the current ones, though suggested by the principle of analogous extension. Instead of coining new terms, I adopted (perhaps with a questionable freedom) these existing ones to ex-

press the Hindu idea of distinctions of chemical substances due merely to difference in spatial position or arrangement among the particles, without any implications whatever as to percentage composition or molecular weight. A study of the original sources has made it clear to me that a "Bhúta" in Hindu Chemistry represents a class of elements composed of similar atoms, and the different elementary substances comprised under one and the same "Bhúta" are 'isomers', in this limited sense, in reference to the atoms, being specifically constituted by differences of spatial position and arrangement among the latter. This is true of the Sāṅkhya-Pātañjala and the Nyāya-Vaiśeṣika alike. But in the Sāṅkhya-Pātañjala, the atoms themselves are composed of Tanmātras; and in one view, the atoms that enter into the "isomeric" modes of the same "Bhúta" are themselves "stereo-isomers" in reference to the Tanmātras. A tri-Tanmātric atom, for example may have different isomeric forms which would account for the divers modes of the "Bhúta" originating with this class of atoms. Hence under the Sāṅkhya Pātañjala, I speak of "isomeric" atoms, while under the Nyāya-Vaiśeṣika I confine myself to the phrase "isomeric modes of the same Bhúta". It appears to me also that in the Sāṅkhya-Pātañjala view, while an atom of a particular kind (say a tri-Tanmātric or a tetra-Tanmātric one) may have "isomeric" forms of its own, the

atoms of the different "Bhūta" classes (from the mono-Tañmātric to the penta-Tañmātric) are what may in a broad sense be termed polymers of the A'kāśa Tanmātra and Bhūtādi (matter-rudiment). Under the Sāṅkhya-Pātanjala, therefore, I have spoken of "polymeric" atoms and "polymeric" combinations of these, though I must confess that I have done so with great diffidence and hesitation.

VICTORIA COLLEGE,
COOCH BEHAR.
23rd May. 1909.

}

B. N. SEAL.

CONTENTS

INTRODUCTION

CHAPTER I

ON THE AGE OF NAG'ĀRJUNA AND

BUDDHIST ALCHEMICAL TANTRAS

Rise, Development and Propagation of Maha'ya'nism—
Na'ga'ryuna: a Leading Representative of Maha'ya'nism—
Na'ga'ryuna as an Adept in Magic and Alchemy—Na'ga'ryuna
as a Contemporary and Friend of King Sadva'hana—
Na'ga'ryuna as a Comprehensive Name of the Activity of
Maha'ya'nism—Asamga—Gradual and Imperceptible Fusion
of Maha'ya'nism with Saivism—Dha'ranis as the Precursors
of the Tantras—Vaipulya Sūtras—Buddhistic Tantras—
Tantras imported into Tibet—Rasaratna'kara—Its Historical
Importance—Also a Typical Production of the Maha'ya'nist
Period of Intellectual Activity—Antiquity of Alchemical
Tantras—Alchemy an Integral Part of Maha'ya'nist Activity
—Spread of Alchemy—In Tibet and the Deccan ... i-xlix

CHAPTER II

Further Cultivation of Alchemy—Buddhist Alchemical
Tantras absorbed into Hindu Tantras—Rasahridaya—
Rasendrachu'da'mani—Rasapraka'sasudha'kara—Rasakalpa-
Rasara'jalakshmi l-lx

CHAPTER III

(Circa 1350 A. D.)

Rasaratna'kara by Nityana'tha—Rasendrachinta'mani—
Rasasa'ra—Sa'rngadhara-sa'mgraha—Rasendrasa'rasa'mgraha—
Rasendrakalpadruma—Dha'turatnama'la' ... lxi-lxxv

CHAPTER IV

Modern Period (1500-1600 A.D.)

Rasadīpa—Rasakaumudi—Bha'vapraka'sa—Arkapraka'sa
lxxvi-lxxxii

CHAPTER V

Indigenous Origin of Indian Alchemy

lxxxiii-xciii

CHAPTER VI

Some Noted Indian Alchemists and Their Works

xciv-xcvi

THE TANTRIC PERIOD

(Continued from Vol. I.)

Chemistry in Rasaratna'kara of Na'ga'rjuna 1-9

Chemistry in Rasahridaya of Bhikshu

Govinda

9-12

Chemistry in Ka'kachandesvari'mata

Tantra

12-13

Chemistry in Rasendrachu'da'mani of

Somadeva

14-16

Chemistry in Rasapraka'sa-sudha'kara of

Yasodhara

16-18

Chemistry in Rasachintamani of Mada-

na'nta Deva

18-19

Chemistry in Rasakalpa (Rudraya'mala

Tantra)

19-22

Chemistry in Rasara'jalakshmi' of Vishnudeva	22
Chemistry in Rasanakshatrama'lika' of Mathanasimha, Physician to the King of Malwa	22-23
Chemistry in Rasaratna'kara of Nitya-na'tha	23
Chemistry in Dha'turatnama'la'	23
Chemistry in Rasapradi'pa	24
Chemistry in Dha'tukriya' or Dha'tu-man'jari' (Rudraya'mala Tantra)	24-27
Chemistry in Suvarnatatra or Svarnatantra	28-29
Knowledge of Gems	
Relative weight—Hardness—Lustre, Transparency, Colour and other Optical Properties—Fusibility—General and Concluding Remarks	30-41
Note on the Method of Preparing Caustic Alkali	42-43
The Tantrists, the Rosicrucians and the Seekers after Truth	44-49
The Metals and their Loss in Weight after Calcination	51-53
Antimony	54
The Preparation known as Svarna-sindu'ra or Makaradhvaja	55-57
Identification of Metals by their Colouration of Flames	57
The Age of Bhikshu Govinda, the Author of Rasahridaya	57-58

**THE MECHANICAL, PHYSICAL AND
CHEMICAL THEORIES OF THE
ANCIENT HINDUS.**

(By Principal B. N. SEAL)

The Sa'nkhya-Pa'tanjala System

Prakṛiti, the Ultimate Ground—The Original Constituents and their Interaction—The Starting Point—Beginning of Evolution—Formation of Wholes or Systems—Collocation of Reals—The Formula of Evolution—The Conservation of Energy (and of Mass)—The Transformation of Energy—The Doctrine of Causation a Corollary from the Conservation and Transformation of Energy—The Principle of Collocation—The Storing-up and the Liberation of Energy—Chain of Causation—Fixed Order—Time, Space and the Causal Series—Space as Extension and Space as Position—The Causal Series—The Dissipation of Energy (and of Mass)—Their Dissolution into the Formless Prakṛiti—The Evolution of Matter—the Genesis of the Infra-atomic Unit-potentials and of the Atoms—Cosmo-genesis, a Bird's-eye View—Chemical Analysis and Synthesis—Elements and Compounds 59-124

Chemistry in the Medical Schools of Ancient India

Physical Characters of the Bhūtas—The Maha'-Bhūtas—Mechanical Mixtures—Qualities of Compounds—The extant Charaka and Susruta—Succession of Medical Authorities—Preparation of Chemical Compounds—Chemical Compositions and Decompositions—Organic Compounds—Poisons—Foetal Development (after Susruta)—Chemistry of Digestion—Formation of Molecular Qualities in Chemical Compounds—Chemistry of Colours—Parima'ma-va'da versus A'rambha-va'da 124-158

Weights and Measures

Measures of Time and Space—Bha'akara'cha'ryya, a Precursor of Newton in the Conception of the Differential Calculus and its Application to Astronomy—Measures of Weight and Capacity—Size of the Minimum Visible (Atom) 158-168

Vedantic System

Máyá—Evolution of Different Forms of Matter—Panchi-
karana 168—176

The Atomic Theory of the Buddhists 177-178

The Atomic Theory of the Jains

General Properties of Matter—Atomic Linking 178-185

The Nyáya-Vaisesika Chemical Theory

Theory of Atomic Combination—Chemical Combination—Mono-Bhautic Compounds—Hetero-Bhautic Compounds—The Theory of Dynamic Contact (Vishambha)—Oils, Fats, Milks—Mixtures like Soups, Solutions, etc.—Chemical Action and Heat—Light Rays—Theory of Reflection, Refraction etc.—Arrangement of Atoms in Space—The Foundations of Solid Co-ordinate Geometry—Three Axes of Va'chaspati—Graphic Representation of the Constitution of a Bi-Bhautic Compound (with "complex contact") 185-215

Conception of Molecular Motion (Parispanda)

Parispanda—Gati-Santa'na—Current and Wave Motion—Vibrations and Waves of Water—Sound-Waves—Different Views of their Nature—Rays of Light 215-221

The Date of Rasaratnasamuchchaya 222-223

The Weight of Air (By Principal B. N. Seal)

223-224

APPENDIX

THE HINDU DOCTRINE OF SCIENTIFIC METHOD

Doctrine of Scientific Method—Test of Truth—Perception—Observation and Experiment—Results in the Different Sciences—Fallacies of Observation—Doctrine of Inference—The Cha'rva'ka View—The Buddhists, their Analysis and Vindication of Inference—Causality and Identity of Essence—How to ascertain Concomitance—Specific Cause and Specific Effect—Canon of the Method of Subtraction—The Joint Method of Difference (Panchaka'rani)—Proof of the Method—Doubt and its limits—The Nya'ya Doctrine of Inference—Definition of a Cause—Unconditional Antecedent—The Doctrine of Anyatha'siddha—Elimination of the Irrelevant Factors—Nya'ya objection to the Method of Difference—The Nya'ya analysis of the Causal Relation Continued—Co-effects—Synchronousness of Causes and Effects—Plurality of Causes—The Nya'ya ground of Inference—Vya'pti or Unconditional Concomitance—Ascertainment of Vya'pti—Upa'dhi—Process of disproving suspected Upa'dhis—Tarka or U'ha—Difference between the Nya'ya Method and Mill's Joint Method of Agreement—Other Instances of Vya'pti—Relation of Causality to Vya'pti—Plurality of Causes—Scientific Methods as subsidiary to General Methodology and the Ascertainment of Truth—Hypotheses—Conditions of a Legitimate Hypothesis—Nirṇaya or Verification of a Hypothesis—The Deduction Method—Navya Nya'ya and its Significance in the History of Thought—Applied Logic—The Logic of the Particular Sciences—The Scientific Methods as applied to Therapeutics—The Scientific Methods as applied to Grammar and Philology—Conclusion

ADDENDA

EMPIRICAL RECIPES OF CHEMICAL TECHNOLOGY

Searing of Rocks—Hardening of Steel—Preparation of
Cements—Nourishment of Plants 285-290

ERRATA

SANSKRIT TEXTS

Extracts from Rasaratna'kara	3-17
Extracts from Rasahridaya	18-41
Extracts from Ka'kachandesvari'mata Tantra	42-50
Extracts from Rasendracu'da'mani	51-56
Extracts from Rasapraka'sasudha'kara	57-67
Extracts from Rasachinta'mani	68-71
Extracts from Rasakalpa	72-79
Extracts from Rasara'jalakshmi	79-82
Extracts from Rasanakshatrama'lika'	82-83
Extracts from Rasaratna'kara	84-86
Extracts from Dha'turatnama'la'	86-89
Extracts from Rasapradī'pa	90-94
Extracts from Dha'tukriya' or Dha'tu- manjari	95-146
Extracts from Suvarnat Tantra or Svarnat Tantra	147-152

INDEX

Index of Proper Names

Index of Subjects



Introduction

CHAPTER I

On the age of Nagarjuna and the Buddhist Alchemical Tantras.

IN the first Volume it has been incidentally mentioned that side by side with the Sivaite Tantras we have their Buddhist counterparts in which the salient features of the former appear.* The question now arises : when did the votaries of the religion of Sâkyamuni find themselves called upon to engraft upon their simple and pure creed the *ensemble* of the gross and grotesque superstitions, the hideous incantations, as also the speculative, the metaphysical and esoteric phases of spiritual aspirations of which the Tantras are the repositories ? The answer cannot be given off-hand

Rise, development
and propagation of
Mahāyānism.

* Vol. i, Intro, lxx.

in a few words, for it will lead us to a discussion of the origin and development of Maháyánism. Under ordinary circumstances we should have considered it beside our purpose to devote much space to this subject in a work dealing with the history of chemistry. But it so happens that the most prominent figure in Indian alchemy, who is acknowledged on all hands to be the discoverer of the processes of distillation, sublimation etc., is no other than the reputed founder of the Mádhyamika system of philosophy, the renowned Nágárjuna. A brief and rapid survey of the causes which led to the origin of Maháyánism and its intimate connection with the tenets of the Sivaite cult will be of help to us.

It is one of the saddest episodes in the history of the great religions of the world that the purity of life, right conduct, right living—in short, the moral code upon which their founders have always laid particular stress, soon begin to occupy a subordinate position and a dogmatic theology springs up in time, which gives occupation to the subtlest intellect.

As for the masses of the people it is doubtful if ever they have remained contented with the mere ethical aspect of a religion. At any rate we find that immediately after the tidings of the death of Buddha had spread about there was a squabble among his followers for the possession of the master's corporeal relics and in course of time stúpas were raised over them, which no less than the three jewels (*Ratnatraya*)—the Buddha, the Dharma and the Samgha,—and the Bodhi-tree became objects of worship of the devotee. The Chaityas, Viháras and other sanctuaries of divers sorts, with which Buddhistic India was dotted over in the first and second centuries after the decease of the great teacher, afforded asylums for a vast multitude of monks, who, freed from all worldly cares, found ample leisure to formulate and draw up a code of spritual and disciplinary exercises.

Although their high ideal was “to lead sweet lives of purest chastity” and induce their lay brethren to follow in their footsteps, rituals and ceremonials of an imposing and

elaborate character soon obscured the ray of light which shone forth from the founder. Thus we find that within 150 years after the passing away of Buddha tedious and circumstantial regulations as to the quality of robes to be worn by the Bhikshus, the mode of bathing and fasting, the taking of the midday meal, the drinking of unchurned milk, probation and penance, dwellings and furniture and so forth were amongst the weighty subjects for discussion in the Second General Council.* We need not pursue the subject further. The reader who is interested in the study of comparative religions will find striking parallels in the early history of the Christian Church.†

* "On the daily Life of the Bhikshus". Vinaya Texts (S. B. E. Series). The Chullavagga, Pt. iii, p. 66.

† The Sermon on the Mount was more or less forgotten. Idolatry disappeared, it is true, but only to re-appear in the shape of Mariolatry and the worship of Saints and relics. In the heat of the schismatic strifes, Christian Charity had to make shift for itself as best as it could. Theologians were busy with the interpretation of the writings of the fathers. In a word, the dogmatic to a large extent superseded the moral element of religion.

We are not concerned here with tracing the rise, progress or decline of Buddhism ; if we have at all referred to its excrescences, it is only to prepare the mind of the reader for the proper understanding of the Maháyánist development.

The India of Asoka and of the fourth and third centuries B. C. was in the main Buddhist, but it should not for a moment be supposed that the old faith was extinct. The triumph and ascendancy of the teachings of Sákya-muni and his followers were due in a large measure to the fact that they drew upon, and incorporated into, their creed much that was essentially of Hindu origin.* As Dr. Bhándárkar observes :—

* Prof. Rhys Davids expresses the same views in several places :—"There is ample evidence even in the books of the orthodox body of Brahman teachers to show that when Buddhism arose there was not only much discussion of the ultimate problems of life, and a keen interest in the result but also that there was a quite unusually open field for all sorts of speculations".—"Buddhism," American Lectures on the History of Religions (1896), p. 26. Again: "But Buddhism is essentially an Indian system. The Buddha himself was,

"But it was not the metaphysical doctrines of Buddhism that influenced the masses of the people. What proved attractive was its ethical side. The Buddhist preachers discoursed on Dharma or righteousness to the people. Such discourses on Dharma without the introduction of any theistic idea have their representatives in the Brahmanic literature. In many of the episodes of the Mahābhārata especially in the Sānti and Anusāsānika books we have

throughout his career, a characteristic Indian....., he was the greatest and wisest and best of Hindus."—*ibid*, p. 117. The same high authority puts it more tersely when he says: "This is partly, no doubt, because we call them Buddhists, and imagine them, therefore, to belong to a separate class, quite distinct from other Indians of that stock. The Buddhists were, as a matter of fact, characteristically and distinctly Indian."—"Buddhist India," p. 165. Cf. "Buddhism, in fact, may be regarded as a reformed phase of Hindu religion and ethical activity. The Buddhistic doctrine of the vanity of the world had been thoroughly disseminated by Yājñavalkya (in the Satapatha Brāhmaṇa) and with it the practice of subsistence upon alms as Pravrajaka or Bhikshu; and a fruitful soil had thereby been prepared for Buddhism". Weber's "Hist. Sans. Lit." trans. 3rd Ed. (1892) p. 285. Again "This teaching contains, in itself, absolutely nothing new; on the contrary, it is essentially identical with the corresponding Brahminical doctrine; only the fashion in which Buddha proclaimed and disseminated it was something altogether novel and unwonted."—*ibid*, p. 289.

simply ethical discourses without any reference to 'God, of the nature of those we find in the Buddhistic works ; and sometimes the verses in the Mahābhārata are the same as those occurring in the latter. There appears to be at one time a period in which the thoughts of the Hindus were directed to the delineation of the right conduct in itself without any theistic learning. And Buddhism on its ethical scale represents that phase. Right conduct is the last of the four noble truths of Buddhism."

• • • • •

"It was this phase of Buddhism that with the strenuous efforts of the missionaries and of the Emperor Aśoka enables it to achieve success amongst the masses of the people ; and what was wanting on the theistic side was supplied by the perfection and marvellous powers attributed to the founder of the religion. Without this faith in the perfection or, what we should call the divine nature of Buddha, a mere ethical religion would probably not have succeeded. Buddhism was not a social revolution as has been thought by some writers. It was a religion established and propagated by persons who had renounced the world and professed not to care for it. From times of old there existed in the Indian community such persons who were

called *Śramanas* and belonged originally to all castes. These gave themselves to contemplation and sometimes propounded doctrines of salvation not in harmony with the prevalent creed. Buddhism was not even a revolt against caste, for though men from all castes were admitted to the monastic order, and though in the discourses of Buddha himself and others the distinction of caste is pronounced to be entirely worthless, still the object of those who elaborated the system was not to level caste distinctions. They even left the domestic ceremonies of their followers to be performed according to the Vedic ritual. This is one of the arguments brought against Buddhism by Udayanāchārya. "There does not exist", he says, "a sect, the followers of which does not perform the Vedic rites beginning with *Garbhādhāna* and ending with the funeral, even though they regard them as having relative or tentative truth."* Buddhism, however, was a revolt against the sacrificial system and denied the authority of the Vedas as calculated to point out the path to salvation. And

*नास्तेषु तद्वर्गं यत्र साङ्गमेतदित्युक्तापि गर्भाधानाद्यन्येष्टिपर्यन्तं
वैदिकीं क्रियां जगो नावृत्तिरिति । *Atmatattvaviveka*, Calc. Ed. of
Samvat 1906, p. 19. साङ्गत्वं relating to संगति a Buddhist techni-
cal term.

this is the root of the hostility between itself and Brahmanism."*

The zealous missionaries of Buddhism captured the heart of the masses by appealing to their moral instincts. Persuasion and not persecution was the instrument they chose to wield. King Asoka proclaimed universal toleration ; he inculcated respect for Brahmins as well as *Sramanas* or ascetics of all sects. It is a relief to find that the mighty monarch had never recourse to brute force for the propagation of his creed. We are spared all the scenes of blood, rapine and violence, which disfigure the pages of religious history in the West.

It has already been pointed out that Buddhism itself may be looked upon as an offspring of Hinduism ; nay, it is a logical outcome of the principles enunciated in the

* "A peep into the Early History of India from the foundation of the Maurya Dynasty to the fall of the Imperial Gupta Dynasty" (B.C. 322—Circa 500 A. D.) pp. 362-363.

Journal of the Bombay branch of the Royal Asiatic Society (1900), Vol. *xx*. No. *LVI*.

Sāmkhya system of philosophy. If India so readily responded to the teachings of the new faith, it is not because she renounced Hinduism but because she found that all that was highest and noblest in the latter was absorbed in the former. The great Teacher who now arose gave only a new shape and direction and a vigorous impetus to the germ of ideas already in existence and turned them to capital account. A good deal of confusion may be avoided by bearing in mind this aspect of the question. When speaking of Buddhist India one is apt to rush to the conclusion that every vestige of Hinduism had disappeared off the face of the vast continent. As a matter of fact even during the zenith of Buddhistic glory Brahminism was rearing its head and was professed by not a few among the cultured and intellectual classes and was ready to assert itself whenever a favourable occasion arose.

In the second century B. C., we find the Kábul valley, the Punjab and Málava ac-

knowledging the sway of the Princes of the Turkish race.* Wema Kadiphses, the second of the Kushana Dynasty is spoken of as a devotee of Mahesvara; his coins bear the emblem of Nandin on the reverse, which is accompanied by a human figure which holds a trident in its right arm representing Śiva. † The last three Kushanas—Kanishka, Huvishka and Vāsudeva—have been noticed in the *Rājatarāṅginī*, ‡ and the emblems on the reverse of their coins are figures of deities borrowed from the Greek, Persian and Brahminical pantheon and of Buddha. Thus the Gods of all these four religions shared the adoration of these Turkish Kings. But the figure of Buddha in the

* Lassen "Indische Alterthumskunde," Vol. ii, pp. 811-13 Ed. 1874.

† *Ibid.*, pp. 808-811.

‡ See next page. Regarding the reliability of the account in the *Rājatarāṅginī*, Dr. Stein observes:—"Kalhana's account of the reign of these kings, who are supposed to have ruled simultaneously, is brief enough, but undoubtedly preserves data of genuine historical tradition. It clearly describes them as princes of Turuska, i. e., Turkish nationality, as powerful sovereigns and as faithful patrons of the Buddhist Church. On these points the statements of

sitting or meditative and the standing posture is to be found on the coins of Kanishka alone.*

In the Buddhist ecclesiastical history Kanishka occupies a prominent place. It was in his reign and under his patronage that the Third Council was held to settle the canon once again. The church was convulsed by internal dissensions and schisms, resulting in its being split up into as many as 18 sects. "The most significant trait of the Third Council is that it closed a period of old quarrels between the sects ; it did not prevent the rise of new aspirations. Maháyánism, which in an incipient stage was already existing ere long, boldly raised its head."†

the Chronicle are fully supported by the evidence of our most authentic records. The continued existence of the three places, Kanishkapura, Hushkapura, and Jushkapura, which are described as foundations of these kings and which still survive to the present day is likely to have assisted in preserving a recollection of their founders."

* Percy Gardner : "Coins of Greek and Scythic kings" pp. 129 ff.

Cunningham : "Num. Chr." 1892, pp. 63 ff.

† Kern : Manual of Ind. Bud. (Grundriss d. Indo-Arischen Phil.) p. 122.

Hinduism was now very much alive. After the Third Council the distinction between the Hínayánists and the Maháyánists became more and more accentuated. The apostles of the latter development became convinced that in order to draw into their folds the bulk of the people some sort of compromise was necessary, that orthodox Buddhism in all its rigidity must be given up. In other words, the neo-Buddhism which now sprang into existence began to absorb and assimilate the popular form of Brahminism and thus swell the ranks of its followers. A purely ethical creed has never secured a following except perhaps among a chosen few. To quote the eloquent words of the historian of "Rationalism in Europe" :—

"There arise from time to time men who bear to the moral condition of their age much the same relations as men of genius bear to its intellectual condition. They anticipate the moral standard of a later age, cast abroad conceptions of disinterested virtue, of philanthropy, or of self-denial that seem to bear no relation to the spirit of their time, inculcate duties and suggest motives of action that

appear to most men altogether chimerical. Yet the magnetism of their perfection tells powerfully upon their contemporaries. An enthusiasm is kindled, a group of adherents is formed, and many are emancipated from the moral condition of their age. Yet the full effects of such a movement are but transient. The first enthusiasm dies away, surrounding circumstances resume their ascendancy, the pure faith is materialised, encrusted with conceptions that are alien to its nature, dislocated, and distorted till its first features have almost disappeared. The moral teaching being unsuited to the time becomes inoperative until its appropriate civilisation has dawned, or at most it faintly and imperfectly filters through an accumulation of dogmas, and thus accelerates in some measure the arrival of the condition it requires." Vol. i, p. 305, Ed 1900.

The same historian in explaining the rapid spread of Christianity in Europe observes in another place :—"It triumphed not so much by superseding rival faiths as by absorbing and transforming them. Old systems, old rites, old images were grafted into the new belief, retaining much of their ancient character, but assuming new names and a new complexion."

Among the bold spirits who took a leading part in this renovation the name of Nágárjuna stands conspicuous. The Mádhyamika system, with its axiom—*sarvam Sunyam*—a form of Pyrrhonism pushed to its extreme limits,

Nágárjuna : a leading representative of Maháyánism.

which is an essential part of Maháyánism, is generally ascribed to him. Northern Bud-

dhist literature is replete with the marvels and miracles performed by him, and tradition has invested him with superhuman powers, Hiouen 'Thsang calls him along with Deva, Asvaghosha and Kumáralabdha, "as the four suns which illumine the world."* As early as A.D. 401-409 we find a life of Nágárjuna Bodhisattva translated into Chinese.† Tárá nátha has committed to writing all the floating mass of legends connected with this venerable name, but as the Tibetan monk wrote so late as the beginning of the 17th century A.D., and as nothing was too astounding for his pious credulity, we have here only

* Julien's texts, Vol. ii, p. 214.

† Bun. Nanjio's Catalogue, Ap. i, No. 3.

nuclei of facts round which have gathered accretions of vast proportions. It is now almost a hopeless task to separate the grain from the chaff. Nevertheless we can glean certain historical data from all that have been handed down. Before proceeding further we think it proper to treat the reader to a specimen of the materials with which one has to deal. We cull the following bits from the "Life and Legends of Nágárjuna" gathered chiefly from Tibetan records including Táránátha's "History of Buddhism."

"A rich Brahmin of the Vidarbha country to whom no son had been born for many years, once saw in a vision, that if he gave alms to, and entertained one hundred Brahmins, he could get a son. Accordingly he made offerings and prayers to the God and entertained one hundred Brahmins. After ten months his wife gave birth to a son. The rich man invited learned astrologers to predict the fortunes of his child ; but they found that it could not live more than a week. In all other respects the child was calculated to be fortunate..... The astrologers assured them (his parents) that if they entertained one hundred Bhikshus, it would

live seven years, beyond which its life could not be prolonged by any means whatever. When the seventh year was about to expire the parents were overwhelmed with grief. To avoid the painful sight of their son's predicted death, they caused him to be removed to a certain solitary place in company with a few retainers.

"As the boy (Nāgārjuna) was passing his mournful days, one day the Mahābodhisattva Avalokiteśvara Khasarpāna visited him in disguise and advised him to go to the great monastery of Nāleन्द्रa in Magadha as the surest means of escaping from the hands of death. He accordingly repaired to that famous Vihāra and arriving at the gate recited some gāthās. During that time the great sage Śrī Saraha Bhadra was the high priest of Nāleन्द्रa, who ordained Nāgārjuna a Bhikshu of the Vihāra. * * * * During the latter part of his office the country was visited by a famine in consequence of which the monks fell into great distress. The Manager became very thoughtful about the terrible effects of the natural calamity. Distress and scarcity compelled the congregation more keenly to feel the necessity of money. The monks now determined to devise some means of acquiring treasures for the support

of the famished congregation, and Nāgārjuna accordingly started on an expedition to visit an island in the great ocean where lived a great saint well versed in the art of alchemy. As the sea could not be crossed by any earthly means, he, by dint of his divine learning, got two leaves of an enchanted tree, by means of which he crossed the ocean and miraculously visited the island and presented himself before the sage who was greatly surprised to see a human being arrived at his abode deemed inaccessible to mortal beings. The sage earnestly inquired how he succeeded in achieving this wonder. Nāgārjuna replied respectfully stating to him the reasons of his visit and circumstances that brought him thither. He also showed him one of the enchanted leaves, concealing the other in his mendicant's platter. He begged him to teach him the art of turning metals into gold. The sage consented to the proposal, but not liking to let the wonderful art be known in Jambudvīpa, he determined to detain him for ever in the island by depriving him of the enchanted leaf. To effect this, he said that he could not teach the art of alchemy unless Nāgārjuna consented to part with the leaf. Nāgārjuna consented, and was taught the art. When it was fully mastered, he flew towards the Indian Continent by the help

of the remaining leaf. Returning to Nālendra, by means of his easily acquired wealth he supported the whole body of monks. By his religious practices he obtained Siddhi (perfection). He refuted the theories of Samkarāchārya* and imparted religious instruction to the monks of Nālendra.

“Nāgārjuna returned to his country after a visit to Uttarakuru and erected many chaityas and temples, composed many works on science, medicine, astronomy and alchemy. After the death of Saraha Bhadra, the office of high priest fell upon Nāgārjuna, which he managed with great ability and indefatigable zeal. He matured the Mādhyamika philosophy which was only conceived by his illustrious teacher Saraha.”

“Nāgārjuna is said to have been a great friend of king De-Chye (Samkara) of S. India, whom he converted to Buddhism.”

* An instance of glaring anachronism. Samkara flourished in the 8th.—9th century A. D. See below, foot-note to p. xxii.

† S. C. Dās : Journ. As. Soc. li. Pt. i, pp. 115—120.

One thing seems to be clear from the above, namely, that Nágárjuna was born and brought up in the Brahminical faith but was afterwards converted to Buddhism and was celebrated as an alchemist.

Táranátha, it is true, completed his History in 1608 A. D., * but he derived his materials from Tibetan sources and the analysis of Dulva by Csoma goes to confirm this account. We have already made use of the record left us by Hiouen 'Thsang. † It is thus clear that all the testimonies concur in ascertaining Nágárjuna not only as the originator of the Mádhyamika philosophy but also as an

Nágárjuna as an adept in magic and alchemy.

adept in magic, conjuration and alchemy, and that even so early as the 7th century A. D. The exact time during which he flourished is a matter of controversy. He is generally regarded as a contemporary of

* Schiefner : *Gesch. d. Bud.* Pref. vi.

† *Vide* Vol. i, Intro. xciii.

Kanishka. One cannot go far wrong in assigning *circa* 150 A. D. as the date of his succeeding to the Patriarchate.*

* According to Lassen Nágárjuna lived about A. D. 23 during the reign of Kanishka. The Rájatarāṅgini says: "Then there were in this land three kings called Hushka, Jushka and Kanishka, who built three towns named after them (Hushkapura, Jushkapura and Kanishkapura)..... During the powerful reign of these [kings] the land of Kāsmír was to a great extent, in the possession of the Buddhas. At that time 150 years had passed in this terrestrial world since the blessed Sákya Simha (Buddha) had obtained complete beatitude (Nirvána)..... And a Bodhi-sattva lived (then) in this country as the lord of the land, namely, the glorious Nágárjuna..... Stein's trans. Vol. I. pp. 30—31. As the tradition of the Northern Buddhists as recorded by Hiouen 'Thsang (Si-yu-ki, l. pp. 99, 151, the Tibetan Dulva (Csoma, As. Res. XX, pp. 92, 297) as also Schiefner (Tar, Gesch. d. Bud. p. 301) concur in placing the commencement of Kanishka's rule 400 years after Buddha's Nirvána, the date assigned here to Nágárjuna is rather curious. Lassen sums up his conclusion on this knotty point in these words:—"Wegen der grossen Anzahl seiner Munzen mus dem Kanishka eine ziemlich lange Regierung zugeschrieben werden ; ich glaube daher annehmen zu dürfen, das er etwa bis 40 nach Chr. G. regiert habe." Fleet maintains B. C. 57. V. Smith c. 120 A. D. While Messrs. Bhánárkar c. 278 A. D. (Journ. Bombay Br. Roy. As. Soc. Vol. XX, No. lvi, pp. 269—366) as the date of Kanishka.

An important document has been preserved for us in its Tibetan and Chinese versions, which seems to have an historical basis. It is in the shape of a "Friendly Epistle of Nāgārjuna to king Udyana."*

Nāgārjuna as a contemporary and friend of king Sadvāhana.

The original in Sanskrit, entitled *Suhrillekha*, has not yet been recovered and probably

been lost. Udyana in the Tibetan subscription is Bdyē-Spyod = Sadvāhana.† This Sadvāhana is a prominent figure in the history of S. India. In ancient Sanskrit literature he is frequently spoken of as a patron of learning and there are several literary reminiscences associated with this name.‡

* *Vide* Wenzel : Journ. Pali Text Soc. (1886), p. 1.

† S. C. Dās (l. c.) says : "Nāgārjuna is said to have been a great friend of king De-Chye (i. e. Saṃkara) of S. India whom he converted to Buddhism." Now De-Chye = Bdyē-byed according to modern pronunciation. Dās is evidently in error in rendering De-Chye as Saṃkara (Wenzel).

‡ *Cf.*—Kāmasūtra of Vātsyāyana. कर्त्तव्यं कुलसः शातकर्षिः शातवाहनी महाक्षेत्री मलयवर्ती [जघान] । Referring to a "new" MS. of *Harshacharita* in his possession Hall remarks—"for Sālivāhana I there find Sātavāhana"—Intro. to "Vāsavadattā," p. 54. This by implication would suggest that the other MS. had the reading Sālivāhana.

Now "the Andhrabhṛityas or Śātavāhanas ruled over the Deccan from B. C. 73 to about A. D. 218, *i.e.*, for about 3 centuries.

"The period during which they ruled over Mahārāshtra must have been a prosperous one in the history of the country. Hence several traditions with regard to different kings have been preserved.. But that Śālivāhana or Śātavāhana was a family name must have been forgotten and different princes of the dynasty have been confounded and identified. Thus Hemachandra in his Desikosha gives Śālivāhana, Śālana, Hāla and Kuntala as the names of one individual." *

The So-to-p'o-ho of the Chinese version of the "Friendly Epistle" has been identified with one of the Śātavāhanas or Andhra kings, possibly Yajna-Srī-Śātakarni. who seems to have reigned about 172—202 A. D. There is, therefore, nothing improbable in this particular, Śātavāhana being a contemporary of Nāgārjuna. In the alchemical Tantra, "Rasaratnākara," ascribed to Nāgārjuna,

* Bhāṇḍārkar's "Early History of the Deccan"—p. 36.

there is a dialogue between this sage and Śālivāhana (p. 6). We shall revert to this subject later on.

Numerous works have been fathered on Nāgārjuna and it is an open question if any of them be genuine.* As is well known Vyāsa or more properly named Vedavyāsa has been taken to be the compiler of not only the four Vedas but also of all the Purāṇas put together. Piety and credulity go hand in hand and are seldom troubled with questions of anachronism. Plato, Democritus and Geber have been held responsible for writings which appeared several centuries later. Names, venerable and illustrious, have often been pressed into service to lend weight and dignity to productions which otherwise would not have commanded a respectful hearing. On the whole we are inclined to agree

Nāgārjuna as a comprehensive name of the activity of Mahāyānism.

* In Bunyin Nanjio's Catalogue of the Bud. Tripitaka there is a list of 24 works ascribed to Nāgārjuna. The *Suhṛillekha* was translated into Chinese in 434 A. D. App. pt. I, p. 368.

with Kern when he says, "The figure of Nāgārjuna, so prominent in the history of the rise of Mahāyānism, shows a double character. It is, on the one side, the name of an influential person, the first eminent leader of a school imbued with Hinduism and the methods of Indian scholastic philosophy. On the other hand, Nāgārjuna is simply a comprehensive name of the activity of Mahāyānism in the first phase of its onward course."*

* In Vol. I of this work (Intro. xciii), we quoted Albérúni as to the date of Nāgārjuna. This cultured Arab, ordinarily a very trustworthy guide, derived his information from the Brahmins of that part of India from which every vestige of Buddhism had disappeared in the 11th century and he was evidently misled on this point as the traditions relating to Nāgārjuna had at that distance of time become very vague. This will be clearly seen from what Prof. Sachau says in the preface to the Arabic edition of Albérúni.

"Its civilization was then essentially Brahminical as it had come to be in a protracted struggle with Buddhism. Albérúni does not know Indian Buddhism from personal experience though it had not yet entirely withdrawn from India and in some part was still a political power. (p. v.)

"The valley of the Kábul river and the Punjab are all that Albérúni has seen of India. (p. xiii.)

"The high schools of Hindu science and learning, Kasmir and Benares, were in Albérúni's time unapproachable for Muslems. (p. xiv.)"

From the time of Nágárijuna onwards Maháyanism began to be tinged more and more with Brahminical bias. A notable and decided step in this direction was taken by Asamga, a monk of Gándhára, who composed the Yogáchárabhúmisastra, in which by assimilating the doctrines of Patañjali he paved the way for the growth of Tantras. He seems to have lived about 400 A. D.* Vasubandhu, Asamga's younger brother, was another zea-

* Cf.—Takakasu : Journ. Roy. As. Soc. 1905.

A life of Vasubandhu was translated into Chinese by Paramārtha. A. D. 557-569.—Bun. Nanj. Cata. p. 371. Csoma Korosi following the Tibetan Chronology says :—"I know that Arya Asamga lived in the sixth or seventh century after Jesus Christ." As. Res. XX, p. 513. This date has been accepted by Lassen (*Ind. Alt.* ii, p. 460) as also by R. Davids (*Buddhism*, p. 207). But this chronology has now become untenable. The date of Asamga and his brother Vasubandhu should be put back by about two centuries, as some of their works were translated into Chinese in the beginning of the fifth century and perhaps earlier. (Bun. Nanj. Cata. App. i p. 371). It must have taken a century or two to have their works sufficiently recognised in India before they would deserve a place in the Chinese Tripitaka.

lous adherent of this school and is said to have been a teacher in the college attached to the monastery of Nálendra—the “Oxford of Indian Buddhism.” From Tibetan sources we learn that the celebrated logician Dignāga was a disciple of Vasubandhu, a contemporary of Lha-tho-ri, king of Tibet, who lived up to 371 A. D.*

Maháyānism now began to adapt itself to its environments. The ab-

Gradual and imperceptible fusion of Maháyānism with Saivism.

sorption of the Yoga ideas made the transition into the

Tantric cult easy and Nor-

thern Buddhism began to develop and expand by entering into an alliance with Saivism, which favoured the growth of Buddhist Tantras. The origin and development of this class of literature have been the subject of a masterly exposition by Burnouf. The Maháyānists not only set up their own deities but borrowed copiously from the pantheon of the Hindus. Thus in the Sivaite Tantras while

* S. C. Vidyābhūṣana : Journ. As. Soc., Vol i, (1905), p. 227.

the God *Siva* is the fountain of all knowledge and sciences, in their Buddhist counterparts we have the celestial, metaphysical and potential Buddhas* occupying the same position. The worship of the female energies (*Sakti*) which plays such an important part in the Tantras was encouraged in the person of *Tára*. The Hindu Gods and Goddesses were also objects of adoration, only they were assigned a subordinate position. The question has often been asked : why did Buddhism seek alliance with Saivism in preference to the Vishnuvite cult ? The answer seems to lie in the fact that it was precisely in those parts of India where the worship of *Siva*, especially in its Tántric form, had struck root that Maháyánism asserted its sway ; † and thus the apostles and propagators of the latter made most of the former. A few centuries later when Vaishnavism gained an ascendancy in Bengal the tables seem to have been turned. A gradual and imperceptible fusion

* i. e. the Bodhisattvas.

† Vide *ante*. p. xi, (under *Wema kadiphses*).

took place between the rival creeds. Thus in the celebrated adoration in the opening lines of *Gītagovinda* we find Buddha freely acknowledged as an incarnation of Vishnu and extolled for his abhorrence of sacrificial rites.*

From Fah-hian's travels we gather that in the beginning of the 5th century A. D., the Mahāyānists were gaining the upper hand, though their rivals, the Hināyānists, were still holding their own in several localities. Thus at Mathurā and Pātaliputra he found the members of both the sects living side by side and having monasteries of their own.

* निन्दसि यश्च विप्रैरुद्धं श्रुतिजातम् सदयहृदयदर्शितपद्मात्मम् । केशव
पूतकुहमरौर जय जगदीश्वरं ॥

It is scarcely correct to assert that Buddhism was exterminated in the land of its birth by cruel persecution. Cf. Vol. i. Intro. lxvii. The Bengali poet Ramechandra Kavibharati, author of *Buddha Sataka*, though a devoted Buddha, belonged to the same class of thinkers as Jayadeva. Pandit S. P. Sāstrī is inclined to place him in the latter end of the 13th century.—*Journal of Buddhist Text Society*, Vol. I. Pt. iii. So late as 1441 A. D. MSS. of Buddhist works used to be copied from in Magadha.—Bendall's *Camb. Cata. of Bud. Sans. MSS* (1883), pref. iv.

From the fact, however, that the pious Chinese pilgrim repeats the *Suramgama Sūtra* for his protection, we may conclude, since he is by no means a pronounced Maháyánist, that the predisposing causes for the origin of the Tantras were already in existence. "In this Sūtra is contained the most complete list of Dháranís (invocations) found in any Chinese compilation. There are 426 distinct sections containing the names of the different Buddhas and Hindu deities worshipped at the time of the composition of the Sūtra. Considering that Fah-hian in the early part of the 5th century regarded this book with reverence. We may reasonably assign it to a period not later than the end of the 1st century. Now amongst the invocations we find distinct reference to Dhyáni Buddha, Vairochana, Akshobhya, Amitábha and others shewing that they were coming to be recognised and worshipped even at that early date." *

* Intro. to Beal's "Fah-hian." (Lxxii).

These Dháranis may be looked upon as the precursors of the Tantras and they fully support the views that when they were composed Buddhism had turned a new leaf. The repeating of certain magic formulas along with the names of Buddha Amitábha, etc., was to secure salvation, in other words, "instead of the old doctrine [of *Karman*]—as a man soweth, so he shall reap—a new and easier way of salvation is here preached, viz., as a man prayeth, so he shall be saved. It is what is known to us as salvation by faith rather than by works. It would almost seem as if this popular and easy doctrine had secured to itself the name of Maháyána, as meaning the Broad Way, in opposition to the Narrow Way, the Hínayána.*

The new class of literature which now arose in order to meet the demands of the Maháyánist revival is collectively known as

* Max Müller, *Buddhist Maháyána Sūtras*. Intro. to larger *Sukhāvati-Vyūha*, ix. S. B. E. Series, Vol. xlix.

the Vaipulya Sūtras or the Sūtras of the developed school, of which the Dhāranis are an integral part. It found expression in such works as the "Saddharmapundarika," "Lalitavistara," "Tathāgataguhyaka," "Prajñāpāramitā," etc., —all of which soon acquired almost canonical sanctity in the estimation of the N. Buddhists. Burnouf has tried hard to differentiate between the simple Sūtras as represented by the literature of the primitive orthodox Buddhism and the expanded Sūtras of which the distinguishing mark is the occurrence of Bodhisattvas.* This drawing of hard and fast

* "La présence des Bodhisattvas ou leur absence intéresse donc le fonds même des livres où on la remarque, et il est bien évident que ce seul point trace une ligne de démarcation profonde entre les Sūtras ordinaires et les Sūtras développés. —Burnouf, Intro. p. 112; *ibid.*, p. 120. Ed. 1844. *Vide* Max Muller's remarks at the end of the Smaller Sukhāvati-Vyūha, p. 102, S. B. E. Series, Vol. xlix.

Cf. also "Some Vaipulyas are, materially, much like the old Sūtras, whole passages *e.g.* of Lalita-Vistara recur almost word for word in the Pāli Scriptures." Kern (*Ind. Bud.* p. 5). This eminent Buddhist scholar also very appositely re-

lines has been found to be well-nigh untenable.*

By the second century A. D. we find the leading beliefs and ideas as crystallised in the Maháyána literature fully in vogue. Thus we

marks elsewhere: "The results arrived at by Burnouf may be right so far as Mahávaipulya Sûtra as a whole is concerned, they cannot be applied to all the component parts of such a work. Not to go further than the Saddh. and the L. Vistara, it can hardly be questioned that these works contain parts of very different dates, and from various sources."—Kern, Intro. to Saddh., pp. x-xi. Passages in L. V. are literally identical with those in Mahāvagga. Again:—"These few examples I have chosen will suffice to prove that the material of a Mahávaipulya Sûtra is partly as old as that of any other sacred book of the Buddhists."—*Ibid.*, xiv.

* The truth seems to be that "the historical relation between the Hínayána and the Maháyána schools of Buddhism is to me as great a puzzle as ever."—Max Muller, Intro. to L. Sukh. Vyúha, ix. Even the very distinction between the N. and the S. Buddhism has been taken strong exception to by R. Davids, who says:—"There is not now and never has been, any unity either of opinion or of language in what is called northern, or in what is called southern Buddhism. There is a distinct disadvantage in continually suggesting a unity which has no existence in fact. In a word the current division of Buddhist literature into northern and southern is entirely unscientific, and misleading."—*Bud. India*, p. 173.

come across in the "Buddhacharita" of Asvaghosha, who is admitted on all hands to be a contemporary of Kanishka, such a passage as this : "this, Sirs, is the Maháyána, the instrument of the law of the perfect Buddha, which is the establisher of the welfare of all beings, set forth by all the Buddhas."* The "Lotus of good Law" was translated into Chinese at the close of the second century A. D. †.

Side by side with the growth of the scriptures another class of literature was called into being by the exigencies of the times—we mean the Buddhist Tan-
tras. Tantras, the necessity for which has been hinted at in the first volume. ‡ However esoteric may be the doctrines sought to be conveyed through the medium of these productions, it would be idle to deny that there

* Cowell's trans. p. 184. S. B. E. Series, Vol. xlix.

† Edkin's "Chinese Buddhism," p. 89. There were several versions of this sacred book.—*Vide* Kern's Intro. p. xxiii (S. B. E. Series).

‡ Vol. i. Intro. lxx.

is much in them which is calculated to pander to the baser instincts of frail humanity. At what particular time these Tantras appeared on the scene is yet a matter of conjecture, but the views of Wilson which held the ground for more than 30 years have now been found to be erroneous. Evidence is now forthcoming from quite an unexpected source, which goes to prove that Buddhist Tantras existed as early as the fifth or sixth century A. D., if not earlier. * If Buddhist Tantras, again, pre-suppose the existence of Hindu Tantras, one need not be considered as rash in assigning an earlier age to the latter.†

* *Vide* the palm-leaf MSS. discovered in the monastery of Horinzi in Japan and carried from Central India. One of these is in the handwriting of a famous Chinese priest, named Kanshin, who came to Japan in A. D. 753. The MS. contains besides a Dhāraṇī, five Tantras. "Bud. Texts from Japan," ed. by Max Muller. Vol. i, pt. i, Intro. pp. 6-8. It is fair to conclude that these Tantras existed in the land of their birth at least two centuries earlier.

† Waddel says :—"No one has yet realised the vast extent to which Mahāyāna and Tāntric Buddhist remains cover India ; nor sufficiently realised the leading part played by the Mahāyāna in Indian Buddhism during its popular period," *Journal of the Roy. As. Soc.* (1894).

The Tantras found a congenial home in China. Amoghavagra, a Sramana of northern India and a Brahmin by caste resided in the Celestial Empire for several years between 746 and 771 A. D., and under his influence the Tántric doctrines dealing with talismanic forms and professions of supernatural power first gained currency there.* Hence long before his time Tantras must have been popular in India. From the eighth to the eleventh century A. D. we are in possession of authentic records as regards the pre-

valence of Tantras in Northern India; as it was about this period that several of these were gradually imported into Tibet by Indian Pandits, but they must have been composed much earlier. †

Tantras imported
into Tibet.

* Bun. Nanjio's Cata. App. ii, p. 445. Amoghavagra translated 77 works including Ushnīsha-chakravartī-tantra, Garuḍagarbhaga-tantra and Vajrakumāra-tantra.

Cf.—Also "The existence of the Tantra Śāstras may thus apparently be traced at least as far back as the 6th century A. D."—*Vide* "Annual Report," As. Soc. Beng. 1906.

† In the first half of the eighth century two eminent

Atisa gave a fresh impetus to Tantrism in the land of snow. From the analysis of Mdo by Csoma we also come to know in detail the names with the dates of the Indian scholars who with the aid of the local interpreters (*lochavas*) rendered into Tibetan the various Sanskrit Tantras. The faithful accuracy with which these translations were made and their fidelity to the original enable us often to reproduce the Sanskrit Texts and thus we are in possession of valuable histori-

Pandits of Bengal visited Tibet at the invitation of its king and formally introduced there Buddhism; these Pandits were Sánti Rakshita, high priest of the monastery of Nálenda and his co-adjutor Padma Sambhava, a native of Udyana, who took charge of the Tántric part of the Buddhist liturgy. They were followed by the sage Dípaṅkara-Srí-jñāna (Atisa), b. A. D. 980, d. 1053. He acquired proficiency in the three piṭakas of the four classes of the Hínayāna Śrāvakas, in the Vaiśeṣika philosophy, in the three piṭakas of the Mahāyāna doctrine, the metaphysics of the Mādhyamika and the Yogācārya schools and the four classes of the Tantras. At the request of king Naya Pála he accepted the post of high priest of the monastery of Vikramasila.—*Vide* S. C. Dás,—Journal of the Buddhist Text Soc. Pt. i.

cal data.* Some of these Tantras deal with alchemy and their contents reveal to us the knowledge of chemical processes in India from about the 6th to the 8th century A. D.†

Fortunately we are not dependent upon the Tibetan Tantras alone for gaining an insight into this dark recess in the history of Hindu intellectual activity. In the course of our search

* Speaking of the Tibetan translation of Arsvaghosha's *Buddha-Charita*, Cowell remarks: "The Tibetan version appears to be much closer to the original Sanskrit than the Chinese; in fact from its verbal accuracy we can often reproduce the exact words of the original, since Sanskrit words are always represented by the same Tibetan equivalents, as for instance the prepositions prefixed to verbal roots."—I. c. Intro. p. x. Waddel is equally impressed with the "profoundly accurate and scholarly nature of the Lāmaist translations of Sanskrit Buddhist books;" and he again observes: "It is clear that the Tāntric and Mahāyāna features of Lāmaism were imported *en bloc* from Indian Buddhism."—*Journal of the Royal As. Soc.* for 1894, p. 15.

† Analysis of the contents of the Mdo (Sūtra) by Csoma de Korosai—*Asiatic Researches*, XX (1836), p. 583. "A work on preparing quicksilver, the most powerful for subduing every sickness and for improving the vigor of the body."—"A work on turning base metals into gold." We are thus reminded of the contents of the *Rasārṇava* and the *Rasaratnākara*. *Vide* p. 2.

for MSS. of alchemical Tantras we have come upon a precious find, in the shape of a Buddhist Tantra, with Nágárjuna as its reputed author. Of alchemical Tantras we have had enough and to spare ; but there is great difficulty in assigning dates to them, as they one and all pretend to emanate from the mouth of the God Siva himself. We are only left to internal evidences—evidences based upon the gradual evolution of chemical processes, which we have not been slow to take advantage of. The MS. in question is a mere fragment, but it is calculated to

Its historical
importance.

 evoke all the zeal and enthusiasm of a Palæontologist—of an Owen or a Marsh—in his efforts to restore an animal and assign to it its proper place in the economy of the laws of evolution, when he luckily chances upon a fossil impression of its tooth or claws. From this point of view Rasaratnákara, for such is the name of our MS., is of uncommon interest. It is a Tantra of the Maháyánist school and as such its invocations are

addressed to all the Buddhas ;* and in one place there is a pointed reference to Prajñá-páramitá †(perfection of wisdom) appearing before Nágárjuna in a dream and revealing to him chemical knowledge.‡

A noteworthy feature of this work is that some chemical processes are discussed in the form of a dialogue between Sáliváhana and Nágárjuna, and Ratnaghosha and Mándavya.§ These last two names are held equally in veneration with Nágárjuna and grateful acknowledgments to their services occur in some later chemical treatises.¶ The bringing together of these four *dramatis personæ*.

* प्रणिपत्य सर्वबुद्धान् । Cf. The opening invocation in the Sukhávati Vyúha : ओ नमः श्रीसर्वबुद्धबोधिसत्त्वेभ्यः । also नमः प्रत्येकबुद्ध आर्यशास्त्राणाम् नमो बोधिसत्त्वानाम् in A'rya Mañjuśrīmūla Tantra.—Vide As. Res. xx, p. 512.

† Cf.—The invocation in Vagrachchhediká नमो भगवत्या आर्यप्रज्ञापारमिताये.

‡ Vide Sans. Texts, p. 10, also Trans., p. 5.

§ Vide Sans. Texts, pp. 12-14, also Trans., pp. 6-8.

¶ Cf. Vol. i, p. 77.

especially of the first two has a significance of its own. We have already seen that references to Nágárjuna and his contemporary king Śáliváhana are only to be met with in ancient classical literature (*vide ante* xxii). It seems probable that Rasaratnákara was written at a time when the memory of these personages was still fragrant. Judging from internal evidences also we come to the conclusion that it is one of the earliest works extant on the subject. In our attempt at throwing light on the text of Rasáruvava, we had to quote several parallel passages from it,* and from a careful perusal of both we are

Also a typical production of the Maháyánist period of intellectual activity.

of opinion that the latter is the inspirer rather than the borrower. Rasaratnákara, in short, seems to us to be a

typical production representing the Maháyánist period of intellectual activity and we may not be wide of the mark if we put down 7th or 8th century A. D. as its latest date.

* *Vide* Vol. i, Sans. Texts, pp. 7, 12, 13 and 18.

From the 5th to the 11th century A. D. the colleges in connection with the monasteries of Pátaliputra, Nálandá, Vikramasila, Udand-pura, etc., were the great seats of learning as the temples attached to the pyramids in ancient Egypt ; and alchemy was included in the curricula of studies.*

The existence of a vast ancient Tántric literature with alchemy as a component part has now been placed beyond doubt, thanks to the searching examination of the Mahárájá's collection of valuable MSS. of Nepal by the eminent scholars Bendall, H. P. Sastri and S. Lévi. Of surpassing interest is the discovery of a Tantra belonging to the extinct school Kub-jikámata, written in Gupta character and copied about the sixth century A. D. This

Antiquity of Al-
chemical Tantras.

* Cf. "By the side of the tower of king Asoka is built a Samghávāsa, belonging to the great vehicle, very imposing and elegant. There is also a temple belonging to the little vehicle.....In the college attached to the temple one may see eminent Sramanas from every quarter of the globe."—Beal's "Fah-hian," ed. 1869, p. 105.

school, though itself very ancient, presupposes the existence of other schools and we have distinct mention of the Maháyāna.* We now learn that the gradual fusion and amalgamation of Sivaite and Buddhist Tantras had begun even anterior to the sixth century. The Kubjiká-tantra was evidently composed outside India proper, probably in Nepal. The Goddess Párvatí encourages her consort to proceed to the continent for the spread of the tenets propounded by it.† In one place we come across a passage ‡ in which Siva himself speaks of párada (mercury) as his generative prin-

* Catalogue of Palm-leaf and selected paper MSS. belonging to the Durbar Library, Nepal, by H. P. Sastri (1905). lxxviii, *et. seq.*

इक्षिणे देवयानी तु पित्रयानस्तधीतरि ।

मध्यमे तु महायानं शिवसंज्ञा प्रतीयते ॥

† मध्य त्वं भारते वर्षेऽधिकाराय सर्वतः ।

‡ महीर्यः पारदो यद् पतितः स्फुटितं मणिः ॥

महीर्येण प्रसूतास्ते तावाप्यां मूनके वदि ।

तिष्ठन्ति संस्कृताः सनाः भव्या वद्विप्रजारणाम् ॥

For the passages cited here we are indebted to the industry and courtesy of Pandit H. P. Sastri, who has wended his way through the bulky MS.

ciple and eulogises its efficacy when it has been killed six times.* We also find allusions to the transmutation of copper into gold with the aid of mercury. In short, we have ample references to alchemical processes described in the very technical terms in which *Rasārnava*, *Rasaratnākara* and other typical works of the Tāntric period abound. †

It is now only necessary to wind up this chapter with an extract from the work of an eminent Buddhistologist with this reservation that the growing influence of Tantrism began as we have seen long before the 8th century.

"The decline of Buddhism in India from the 8th century downwards nearly coincides with the

* Even at the present day mercury, which has been *killed* six times in succession, each time with an equal weight of sulphur *षड्मुषयस्त्रिज्वारित*, is reputed to be one of the most potent of remedies.

† e.g. पक्षिण विद्धिती वेधः किं व्यस्यती न विध्यते ।

रसविद्धं यदा ताम्रं न मृयस्ताम्रतां व्रजेत् ॥

For the meaning of the word वेध (Vedha) see this Vol. p. 18, *footnote*, also Vol. i, p. 120.

growing influence of Tantrism and sorcery, which stand to each other in the relation of theory to practice. The development of Tantrism is a feature that Buddhism and Hinduism in their later phases have in common. The object of Hindu Tantrism is the acquisition of wealth, mundane enjoyments, rewards for moral actions, deliverance, by worshipping Durgā, the *Sakti* of Śiva—Prajñā in the terminology of the Mahāyāna—through means of spells, muttered prayers, Samādhi, offerings, etc. Similarly the Buddhist Tantras purpose to teach the adepts how by a supernatural way to acquire desired objects, either of a material nature, as the elixir of longevity, invulnerability, invisibility, alchemy ; or of a more spiritual character as the power of evoking a Buddha or a Bodhisattva to solve a doubt, or the power of achieving in this life the union with some divinity. There is an unmistakable affinity between Tantrism on one side, and the system of Yoga and Kammattthāna on the other. Tantrism is, so to say, a popularised and, at the same time, degraded form of Yoga, because the objects are commonly of a coarser character, and the practices partly more childish partly more revolting.

“Tārānātha informs us that Tantrism existed and was transmitted in an occult manner in the period

between Asaṅga and Dharmakīrti, but that after Dharmakīrti's times the Anuttarayoga became more and more general and influential. Substantially his statement is certainly right. He adds that during the reign of the Pāla dynasty, there were many masters of magic, Mantra-Vajrācāryas, who, being possessed of various Siddhis, performed the most prodigious feats.

"The kings of the Pāla dynasty, whose sway over Gauda and the adjacent regions lasted from about A. D. 800 to 1050, are known both from the annals and their inscriptions as protectors of the Faith. It was during that period that the monastery of Vikramasīla was a renowned centre of Tantrist learning.

"The Sena kings, who followed the Pālas in the dominion over Eastern India, though belonging to a Hindu persuasion, were not hostile to the Faith. Still Buddhism declined during their reign and more so after the invasion of the country by the Muhammedans in A. D. 1200. The monasteries of Udandapura and Vikramasīla were destroyed; the monks were killed or fled to other countries. The learned Sākyasrī went to Orissa, and afterwards to Tibet; Ratnarakshita to Nepāl; Budhamitra and others sought a refuge in S. India, whilst Saṅgama-Srijñāna with several of his followers betook themselves to Burma, Camboja, etc.

And thus the Law of Buddha became extinct in Magadha.

"Many emigrants from Magadha rejoined their brethren in the South and founded colleges on a modest scale in Vijayanagara, Kalinga, and Kotikan. The comparatively satisfactory condition of Buddhism in Dekkan about that time is attested by the rich donations to the monastery at Dambal."*

It will be noted that the monks of the monasteries of Udandapura and Vikramsila on their dispersion carried with them their learning and arts in the same manner of the

Byzantine Greeks on their
Spread of al-
chemy.expulsion from Constantinople bore with them their intellectual treasures to the Italian cities. In the kingdom of the Deccan and in Tibet the Buddhist refugees found hospitable asylums, † just as the Greek Philosophers did in the Florentine Republic under the Medicii.

* Kern—Manual of Ind. Bud., pp. 133—134.

† Cf.—"The Deccan, which from the eleventh century was the refuge and centre of literary activity generally. In Hindustan it had been substantially arrested by the inroads and ravages of the Muhammadans,—Weber. Hist. Ind. lit. p. 283.

Some eminent orientalists, whose opinions naturally carry weight, have hitherto taken for granted that the knowledge of chemistry such as we find reflected in the Tantras quoted by Mádharma in *Rasesvaradarsana* was derived by intercourse with the Arabs.†

* Vol. i, Intro. lxxviii, *et seq.*

† *E.g.* Barth : "In regard to alchemy, anyhow in which the Sittars are zealous adepts, they were disciples of the Arabians, although other Sivaïtes had preceded them in the pursuit of the philosopher's stone. Already, in his exposition of the different doctrines of the Saivas, Sáyana thought he ought to dedicate a special chapter to the *Rasesvara-darsana* or "system of mercury," a strange amalgamation of Vedantism and alchemy. The object contemplated in this system is the transmutation of the body into an incorruptible substance by means of *rasapána*, i.e., the absorption into it of elixirs compounded principally of mercury and mica, that is to say, of the very essential qualities of Siva and Gauri, with whom the subject of the operation is thus at length identified. This species of transubstantiation constitutes the *jivánmukti*, or state of deliverance commencing with this present life, the sole and indispensable condition of salvation. It is clear that the devotional formulæ of the Vedánta are here only a sort of jargon, under which there lies hid a radically impious doctrine ; and it is not less clear that in this doctrine, which had from the fourteenth century produced a rather considerable literature, there is an infusion of Mohammedan ideas. The Arabs of the Khalifat had arrived on these shores in the character of travellers or merchants, and had established commercial relations and intercourse with these parts long before the Afghans, Turks, or Mongols, their coreligionists, came as conquerors."—"Religions of India," ed. 1891, pp. 210-211.

The attentive reader who has followed us all along could not have failed to notice that it was in the Universities of Nálendá, Udandapura and Vikramasíla, in Central India and Magadha, precisely the regions which were cut off from communication with the external world, that Tantric mysticism with alchemy as an integral part was cultivated and from thence spread to Bhot (Tibet) and the regions lying to the south-east of it,* and South India.†

* See under colophons to *Rasahridaya* and *Rasasāra* respectively.

† The last rallying point of Hindu learning and sciences was the kingdom of Vijayanagara, which was in the heyday of its glory under Bukka I (A. D. 1354-1371) with Mádhava as his prime Minister. Wilson says :—"The history of Vijayanagara is a subject of considerable interest in the annals of India, as the last barrier that was opposed to Muhammedan invasions, and that preserved the southern part of the Peninsula from foreign rule until a very modern period."—*As. Res.*, Vol. xx (1830), p. I. See also Sewell's "A Forgotten Empire"—(Vijayanagara).

CHAPTER II.

Having thus far prepared the ground for believing that alchemy along with other cognate branches of learning was the outcome of Indian intellectual activity, we shall now proceed to follow it up with its further deve-

lopment. At the outset it is, Further cultivation of alchemy. however, necessary to remem-

ber that on the decline of Buddhism the vigorous impetus which its followers gave to literature and science was not lost to India. Nay, during and after the revival of Brahminism under the Gupta dynasty and its successions we have some mighty intellectual giants whose productions will continue to shed lustre as long as the Hindu nation exists. Kálidása and Bhavabhúti, Brahma Gupta and Aryabhata, Samkara and Rámánuja are names which may be regarded as the heritage not of India alone but of the entire civilized world. At the time of the Brahminic revival Buddhist works of acknowledged merit far from

being cast aside were held in veneration. Amarasimha in his Lexicon and Vágbhata in his *Ashtāṅgahridaya* * as also the pseudo-Vágbhata * commence with an invocation to Buddha, which has never shocked the tolerant spirit of the Hindu. Charaka and Susruta also bear distinct impress of Buddhist retouching. The Buddhist Tantras became likewise a part and parcel of Hindu religious-philosophical literature,† the subject-matter

Buddhist alchemical Tantras absorbed into Hindu Tantras.

of the former was incorporated into the latter, the names of Tára, Prajñápáramitá and

Buddha being simply changed into those of Párvatí and Siva. In *Rasaratnákara* itself we have distinct indications that it is an admixture of both.

* Vol. i, p. 76.

† Speaking of a typical Buddhist production belonging to this category Burnouf observes: "Ce morceau est exclusivement spéculatif, et il nous offre une nouvelle preuve de l'alliance intime que le système des Tantras a contractée avec la philosophie buddhique la plus élevée" (l. c. p. 543 ed. 1844).

It should thus be understood that the works under review in this chapter are based upon their Buddhist counterparts ; in short, there is no disposition to ignore the debt of obligation the authors are under to Nágárijuna, Ratnaghosha, Mándavya and others.

In the introduction to the first volume we stated : "It is to be regretted that the several works quoted by Mádhava [on the science of mercury] *Rasárnava* alone *Rasahrída* seems to have survived to our days" (l. c. lxxxiii). Since then we have been fortunate enough to procure as many as three transcripts of MSS. of *Rasahrída* by Govindabhagavat from different quarters. As Mádhava speaks of this author in terms of the deepest reverence and regards him as "ancient,"* we think we should not err on the wrong side if we place the author some three

* Cf. Vol. i, Intro. lxxx.

तत्प्रपञ्चस्तु गीविन्दभगवत्पादाचार्यसर्वश्रामेश्वरसहारजप्रवृत्तिभिः
प्राचीनैराचार्यैर्निरूपितः ।

The qualifying epithet भगवत् is only applied to venerable Rishis of old.

centuries before his time. If our surmise be correct, he should have lived about eleventh century A. D. The only personal allusion which the author has condescended to offer for the edification of posterity is that he wrote his book at the request of the king of the Kirátaland, *i.e.*, the region adjoining modern Bhotan. Portions of this remarkable treatise after a careful collation of the MSS. have been reproduced in the proper place. The worm-eaten fragmentary MS. produced from Benares is 386 years old. Internal evidence equally goes to establish the antiquity of this work. The author was evidently a Buddhist as we learn from the colophon to the Benares MS. (*vide* trans. p. 12). It is, however, not to be found either in the India office or the Nepál MS. This important omission is easily accounted for. It is the reluctance of the latter day Hindus to acknowledge their obligations to a Buddhist author.

Rasárnava which has been noticed at length in the first volume and to which was assigned the 12th century A. D., as also Rasaratna-

samuchchaya (13th to 14th century), need not further arrest our attention.

The presentation of the various treatises of the Tantric and iatro-chemical periods under discussion in their exact chronological sequence is not an easy task ; in the absence of more definite information, we are afraid, we shall now and then have to hazard a conjecture.

The introductory lines of Books viii and ix of Rasaratnasmuchchaya, in which Somadeva is mentioned as the author of the descriptive part, led us to suspect that they are merely reproductions from "a standard work on the subject by Somadeva, no longer extant."* Our surmise has proved to be partially correct. We have at last been able to recover the supposed lost work. A transcript of a MS. of Rasendrachūdāmani by Somadeva, preserved in the Library of the Deccan College, Poona, reveals to us the fact that

* Vol. i, p. 118.

practically all the important portions of this book have been woven into the text of *Rasaratnasamuchchaya*; and this gives us an additional opportunity of collating many doubtful passages in both. But the present work itself does not lay claim to originality. It makes a candid admission that it culls all its materials from pre-existing chemical treatises.* It further puts forward the alchemist Nandi as the inventor of the process of sublimation and of the *Koshthi* apparatus (Vol. i, pp. 69 and 89).† *Nágárjuna*, *Dandī*, *Sambhu* and the sage *Brahmajyoti* are also spoken of as sources of his inspiration. We get very little inkling into the personal history of *Somadeva*, except that he was the ruler of a city named *Karaválabhairava*. The fact that *R. R. S.* lays *Rasendrachudámani* so amply under contribution would suggest that the latter had become somewhat rare

* अथ यन्त्राणि वक्ष्यन्ते रसतन्त्राण्यनेकशः ।

समालोकाय समासेन सोमदेवेन साम्प्रतम् ॥

† ऊर्ध्वपातनयनां हि नन्दिना परिकीर्तितम् ।

कीदृक्कायनमेतद्धि नन्दिना परिकीर्तितम् ॥

or that its contents had been well-nigh forgotten when the former was compiled. Its date may therefore be put down between the 12th and 13th centuries A. D.

Another important work of this period is *Rasaprakāśa-sudhākara* by Yasodhara. The author of R. R. S. in the opening lines mentions the names of 27 alchemists to whom he is beholden, among which occurs that of Yasodhana. We have little doubt that the

Rasaprakāśa-sudhākara. correct reading is Yasodhara.

We now find that there is very little original matter in R. R. S., it being made up of citations from *Rasārṇava* and the works of Somadeva and Yasodhara. We should not, however, be understood to retract the high encomiums we thought fit to bestow upon R. R. S. for "its methodical and scientific arrangements of the subject-matter, which would do credit to any modern work."* Its author has never laid claims to originality, but, on the contrary, has freely acknowledged the sources he drew upon. The student of

* Vol. i, Intro. lxxxvi.

Hindu chemistry, however, like a weary but devout pilgrim, must wind his way through intricate and thorny paths and feel ineffable joy at being able to approach the original fountain undefiled. It now transpires that the credit for the accurate observations on the metallurgy of zinc (Vol. i., pp. 88 & 156) really belongs to Yasodhara. While the author of B. R. S. always scrupulously admits that his work is a mere compilation, Yasodhara, on the other hand, is anxious to let the world know that the processes he describes have been verified by experiments performed with his own hands.* Among the authorities he cites are Nágárjuna, Devísástra (probably Rasárnava), Nandi, Somadeva, Svachchhandabhairava and Manthanabhairava. As Yasodhara quotes Somadeva, he must have been posterior to the latter by at least a hundred

* *Of.* स्वहस्तेन कृतं सम्यक् कारणं न युतं मया ।

स्वहस्तेन भवयोगिन कृतं सम्यक् युतेन हि ॥

धातुबन्धनतीर्थीऽसौ स्वहस्तेन कृतो मया ।

इहप्रत्यययोगीऽयं कथितो नात्र संशयः ॥

years and he should therefore be placed in the 13th century A. D. *

Rasakalpa likewise seems to belong to this period. It is in the shape of a Tantra, but curiously enough it is not much troubled with consistency. In the opening salutation Siva, "the king of mercurial lore" and his consort *Chandikā* are reverentially bowed to—a procedure scarcely reconcilable with the position of a revealed document. The colophon at the end of each Chapter (उद्गास) claims the work to be a part and parcel of *Rudrayāmala Tantra*; at the same time due acknowledgment is made to the contributions of Govinda, the author of *Rasahridaya*, *Svachchhandabhairava* and other adepts.† Towards the end the author says: "The processes described have all been verified by me and not borrowed at second-hand from my teachers." Needless to add here that the God *Siva* would not have

* We are using a copy of the MS. preserved in the Runbîr Library, Kāsmîr. The readings are on the whole accurate.

† E. g. सञ्वाचार्यैरुदीरिताः ।

been at pains in justifying the necessity of his production with such a timorous apology. From internal evidence it is abundantly clear that it could not have been composed earlier than the 13th century A.D.

As the author has confined himself solely to a description of the metals, minerals and the processes of "killing" them with the agency of various apparatus and has not gone into the treatment of diseases with the aid of mineral preparations, he has been able to condense much important information within the narrow compass of a few short chapters.

Rasarājalakshmi also deserves some prominence here not because of its intrinsic worth but because of the references to previous Tantras and alchemists, amongst which are Rasār-nava, Kākachandīśvara, Nágárjuna, Vyádi, Svachchhanda, Dámodara, Vāsudeva and Bhagabat Govinda. We have also categorical mention of the purely Ayurvedic works such

as Charaka, Susruta, Háríta and Vágbhata, to which our author is equally indebted.* From the colophon to the MS. procured from Benares we learn that the author Vishnudeva was Court Physician to king Bukka.† If this statement be accepted—and *prima facie* there is no reason to question it—this treatise must have been compiled in the latter part of the 14th century. Internal evidence equally supports this date.

* *Vide Sanskrit Texts*, pp. 80-81.

† *Vide ante.*, footnote, xlix.

CHAPTER III.

C. 1350 A. D.

We now proceed to examine the contents of another series of works belonging also to the Iatro-Chemical period ; the one characteristic feature of which is that opium is recognised as an official drug in the *materia medica* portion. These may be taken to date from the middle of the 14th century A. D.

Rasanakshatramáliká by Mathanasimha, physician to the king of Malwa, should find a place in this chapter. For particulars as to the contents the reader may consult p. 22. The date given by the copyist of the MS. is Samvat 1557 i.e. 1500 A. D. The work itself is therefore older.

Rasaratnákara by Siddha Nityanátha, son of Párvatí, comes under this category.* The author gives the sources of his information and explains the object of his compila-

* Two editions of this somewhat voluminous work have been published—one by Ganesa Chandra Ghose (Calcutta),

tion in the following words : “Whatever has been revealed by Siva in Rasárnava under the preparations of mercury ; the Dípiká of Rasamangala on mercury ; all that has been said by Nágárjuna for the benefit of people afflicted with diseases, as also by Siddha Charpati, by Vágbhata and Su-sruta,—all these and many other treatises on mercury and minerals being consulted, I have, after rejecting the drugs and medicaments which have become rare and difficult to procure, put together [in my work] the essential features thereof. * * * * All that I have learned from my teachers and have been in a position to subject to practical tests has been incorporated into my work for the benefit of mankind.” In addition to the authorities cited above Nityanátha quotes from Chakrapáni and Rasendrachúdámáni (*ante* liv).

the other at the “Venkatesvara Press” (Bombay). We have compared the readings of these two editions with the MS. in the Library of the Sanskrit College, Calcutta. They agree fairly well.

Rasendrachintámani will next claim our
 attention. We have before
 Rasendrachintá- us the printed copy, edited by
 mani.

Umesa Chandra Sena Gupta,

late librarian, Sanskrit College, Calcutta, in
 which the text has been adopted, as the
 editor informs us in the preface, after colla-
 tion of 3 or 4 MSS. We have carefully gone
 over this edition and compared its readings
 with those of a MS. procured from Benares
 and another from the Runbir Library, Kásmír.
 All these agree in the main, but there happen
 to be certain omissions and additions, which
 form an interesting chapter in the history of
 interpolations in the literature of this descrip-
 tion. To begin with : there is a dispute over
 its very authorship. Some MSS. ascribe it
 to *Dhundhukanátha*, disciple of *Kálanátha*,
 others to *Rámachandra*. After the custom-
 ary salutation there occur two couplets in
 the Calcutta edition, which are not met with
 in the Benares and Kásmír exemplars. In
 these the author is made to justify his *raison*
d'etre for undertaking his task in these words :

"I shall give publicity only to such processes as I have been able to verify by my own experiments." Such protestations have already been noticed more than once.* In another place we have : "Those mercurial operations alone have found a place in my book, which I have been able to put to tests. Those who teach without being able to perform experiments labour in vain." This last couplet is quite out of place as it hangs like a tail to a long extract from *Rasārṇava* and is in fact conspicuous by its absence in the Benares and Kásmír MSS.† For the second time we find calomel designated as *Rasakarpūra* (lit. camphor of mercury ; *vide* vol. i, p. 250). This preparation no doubt occurs in the older

* Such pretensions put forth on behalf of the author, especially in the first person singular, lead one to suspect that they are later interpolations. In the Arabian alchemy Geber is often made to declare to the same effect : *e.g.* "J'ai expérimenté moi-même tout ce que je rapporte."—Berthelot, "*La Chimie au moyen Âge*," t. 1, p. 338. The well known egoistic couplet in *Susruta*, Ch. i, चङ् हृ धन्वन्नरिरादिदेवः is generally regarded as an interpolation.

† The extract commences with त्वं माता सर्वभूतानां.

works, *e. g.* *Rasárnava* ; but it is described there as the white “ash” of mercury (*sveta-bhasma*). The recipe for calomel as given in the Calcutta edition, however, is quite different from that in the Benares and Kásmír MSS. and it is altogether wanting in one of the MSS. in the Calcutta Sanskrit College Library. We are therefore not without suspicion that it has been foisted into the original composition. The author refers to *Rasárnava*, *Nágárjuna*, *Govinda*, *Nityanátha*, *Siddha Lakshmisvara*, *Trivikramabhata* and *Chakrapáni*. There is a lengthy colophon but no direct information can be derived from it as to the age of the author.

Rasasára : It is a comprehensive but purely chemical work dealing with 18 operations on mercury ; various chemical processes are incidentally described, a good many of which, however, overlap each other. There does not seem to be any justification for coining a multiplicity of technical jargons to connote each of these. But prolixity was never regarded in the light of a vice by the

alchemical writers of the middle ages either in India or in Europe. The contents of *Rasasāra* often remind us of a poem on alchemy by George Ripley, canon of Bridlington in Yorkshire (b. about 1460), of which Rodwell says :—

"But we cannot point to a new fact which he elucidated. He divided all chemical operations into twelve processes—calcination, dissolution, separation, conjunction, putrefaction, congelation, cibation, sublimation, fermentation, exaltation, multiplication and projection. Several MS. copies of his poem exist in the British Museum, bound up with copies of the works of Roger Bacon and earlier writers. Here is a specimen of his rugged rhymes :—

The first chapter shall be of natural *Calcination*;

The second of *Dyssolution*, secret and phylo-
sophycall ;

The third of our elementall *Separation* ;

The fourth of *Conjunction* matrimoniall ;

The fyfth of *Putrefaction* then followe shall :

Of *Congelation* *Albyficate* shall be the Sixt,

Then of *Cybation*, the seventh shall follow
next."•

* *Vide* "Birth of Chemistry".

The author, Govindáchārya, as a devout Hindu, begins with his adoration of *Siva* and *Vishnu* and tells us at the outset that his treatise is a compilation and epitome based upon standard works on the subject and the contributions of the adepts. We have every reason to be thankful to him for the many hints he throws on the sources of his information. Of surpassing interest is his declaration that for a knowledge of certain processes he is indebted to the Buddhists of Tibet.* This must be taken to mean that the cultivation of alchemy had become neglected and almost forgotten in India proper and the earnest searchers for this lore had to repair during the time of our author to Tibet. Confirmatory evidence to this effect is equally

* एवं बौद्धा विज्ञानानि भाटदेवनिवासिनः ।

Towards the close of his work the author again acknowledges his obligation to the Buddhists.

बौद्धमतं तथा ज्ञात्वा रससारः कृतो मया ।

We have in our possession five transcripts of the MSS. of *Rasasāra* procured from the Libraries of *Kāsmīr*, *Tanjore*, *Ulwar*, *Madras* and the Temple of the Goddess *Kālī*, at *Ramnā*, near *Dacca*, *Bengal*.

furnished in the colophon to *Rasahridaya* (trans. p. 12). During the decadence of Buddhism and the corresponding ascendancy of Brahminism in Bengal, say about the 11th to 13th centuries A.D., this branch of science also found a safe retreat in the land of the Kirátas as we have already seen. Burnell, under the influence of his preconceived notion, namely that Indian alchemy owed its origin to the Arabs, very naively remarks : “By *Bauddhas* he (the author) probably means the Muhammedans (*of* the vernacular Malayálam use of the word), though studies of this nature were much pursued by the later Buddhists.”*

Some idea of the date of *Rasasára* may be formed from the fact that there is mention of opium in it. But our author was evidently quite in the dark as to its origin ; for, says he : “There are 4 different kinds of poisonous

* Catalogue of the Tanjore Palace MSS. pt. 1, p. 70. Burnell draws his conclusions from the reference to Buddhists in the colophon ; but we have quoted above another passage in which distinct mention is made of the Buddhists of Tibet.

sea-fish, and it is from their foam that 4 different kinds of opium are derived, namely, white, red, black and yellow ; while others maintain that it is derived from the foam of the snake and it is very properly used for chemical operation,"* *e. g.*,—killing and fixation of mercury. From the context it is, however, doubtful if the narcotic drug is really alluded to here. But independently of the use of this term we may safely place this work in the 13th century A. D.

* समुद्र चैव जायन्ते विषमस्त्राद्यतुर्विधाः ।
 तैभ्यः फेनं समुत्पन्नम् अहिफेनी विषं स चतुर्विधं ।
 केचिद्वदन्ति सर्पाणां फेनं स्यादहिफेनकं ।
 यथा—धारणं श्वेतवर्णे च रक्तवर्णे च जारकं ।
 सारणं पीतवर्णे च कृष्णवर्णे च मारकं ।
 विषविदुत्तमं फेनं युज्यते रसकर्त्तुणि ।

The Sanskrit word for opium, "ahiphena," lit., foam of the snake, is of modern date. It is generally held that this word has been Sanskritised from the Arabic "aphiyūn."

These indentical distichs also occur in the commentary on Sārṅgadhara by A'dāmaḷla with the additional line, षाषजः (खाखजः) चौरविशेषः, namely, it is the milky juice of poppy ; proving that during the time of the latter its real origin was known, at the same time its supposed origin was not disbelieved.

Sārṅgadhara-saṁgraha—a compilation by *Sārṅgadhara* : its peculiarity is that it is based upon the *A'yurvedas* (*Charaka*, etc.) on the one hand and the Tantric chemical treatises on the other. In the chapter on the purification and incineration of metals, 7 of these are recognised, but strange to say there does not occur any mention of zinc. Later on, 9 metals are named including two alloys, brass and bell-metal, after the 9 planets, the significance of which will be discussed in the proper place.

The date of *Sārṅgadhara* can be ascertained with accuracy, as besides this medical compendium he is the author of the *Pad-dhati*, a voluminous miscellaney, containing, with other matters, a poetical anthology. The author dates his work in *saṁvat* 1420 or A. D. 1363. The name of the author's father is *Dāmodara* and that of the grandfather *Rāghavadeva*. The latter was highly considered by *Rājā Hammīra*, the Chauhan.*

* After the sack of Chitor by Alla-ud-din in A. D. 1303, Mewar was occupied by the garrisons of Delhi. Hammīra

There is a big commentary on this work by A'dhamalla, whose ancestors settled in the city founded by Hammíra.*

Rasendrasárasamgraha : The author, Gopálakrishna, begins by admitting that his treatise is a mere compilation based upon many Tantras, though he mentions by name only two, namely, Rasamañjari and Chandriká. Special stress is laid on the therapeu-

recovered his ancestral throne and during his prosperous rule of sixty-four years (1301-1365) and that of his successors arts and literature found liberal patrons (*vide* Tod's "Annals of Rájastan"). The court of Hammíra attracted another distinguished physician named Saugata Siṃha as we gather from the colophon to a noted recipé,

एषा सौगतसिंहनाकभिषजा लोके प्रकाशकता

इन्दौराय महीभुजे * संभोजभाजे मृशम् ।

* A'dhamalla gives an account of his family. His Grandfather was one Chakrapáni, not to be confounded with the celebrated medical author of Bengal (Vol. i, Intro. liv) and he himself was attached to the court of a ruler named, Jaitrasimha, whose capital Hástikántapuri was situated on the river Charmanvati. We reproduce in the next page the text which is somewhat corrupt from the copy preserved in the Library of the Sanskrit College, Benares.

tic efficacy of mineral preparations.* Like Rasendrachintāmani it assigns a minor place to the ancient Ayurvedic method of treatment by kashāyayoga, i. e., by herbs and simples ; as far as the knowledge of chemical processes goes, it must be held inferior to the former. Numerous medicinal recipés

श्रीवास्तवकुलप्रकाशमणयो ये पूर्वजा विदुताः

श्रीहृन्मीरपुरे * * * *

तदन्वये किं बहुना प्रसिद्धश्रीचक्रपाणिः कुलकेरवेयुः(न्दुः)

* * * * *

तस्य बुद्धिसुमगस्य तन्मूर्ती भावसिंह इति भूपतिमान्यः ।

* * * * *

तस्यात्मजी दीर्घमति प्रहृष्टो नाखादमहो * *

तेन * * वीनाश्रयति (?) (विनाश्रयति) शार्ङ्गधरप्रकाशः ।

हालीकालपुरी पुरा पुरजिता काशीय विद्वज्जनै-

र्यान्ता यत्र सरःसरिद्रव्यवरा चर्मखती पापहा ।

यस्या उद्गतवासुदेवचरणहन्ताम्बुजः आपतिः

ख्याती चर्मदवाप्ति चर्ममतिषु श्रीजैतसिंहः प्रभुः ॥

तस्या शार्ङ्गधरोक्तानां योगानां च प्रकाशिनी ।

क्रियते सादृमन्त्रेण संहितायाः प्रदीपिका ॥

* For a description of some of these *vide* "Journal des Savants," April, 1898.

agree word for word with those in Rasendra-chintámani, which only proves that both have drawn on a common stock. There is no question of the one borrowing from the other, as internal evidence proves that both belong to the same period. Abhayánanda Gupta in the preface to his edition says :—"There is a tradition to the effect that Gopála Kavibhúshana of Dakshina Vāṅga is the compiler of this book ; but this can scarcely be accepted as he lived not long ago." Again. "Its commentator, Rámasena Kavíndramani (author of Arthabodhiká) was court physician to Nawáb Jaffer Ali Khan of Bengal (Mir Jaffer) some 200 years ago." Rámasena himself quotes from 3 commentaries of this book ; hence it was recognised as of some degree of importance at that time and must have been composed long before. This work is very popular in Bengal and is a *vade mecum* of the local Kavirájas.

Rasendrakalpadruma is another work of this period. It deals chiefly with mineral preparations and is a mere compilation from

Rasárñava, Rasamañgala, Ratnákara, Rasá-mrita and Rasaratnasamuchchaya ; the numerous citations with which it is replete are of some use in correcting many doubtful readings in these latter. Our MS. is incomplete, the first few couplets and the sequel being lost ; for the opening lines of the work see Aufrecht's Catalogue of the Bodleian Library, MSS., pt. 1, p. 321.

Dháturatnamálá : This epitome is devoted exclusively to short processes of *killing* metals and minerals. Six metals are recognised at the outset, namely, gold, silver, copper, lead, tin and iron as in the ancient works; but strange to say later on *kharpara*,* which is the mineral calamine, is taken as synonymous with *jasada* or zinc. We have before us a MS. procured from Benares. It is full of corrupt readings. The copy noticed in the Bodleian Library Catalogue seems to be more correct. From the colophon in the latter we learn that the author is one Devadatta of Gujaráta, but in the Benares exemplar

* Vol. i. p. 158.

this portion has been coolly tampered with, so that this poor compilation may be palmed off as an integral part of a *Samhitá* of the *Asvinikumáras*, the divine physicians, and thus entitled to the respect due to revelation. This work cannot be placed earlier than in the 14th century. Here we have a serious sidelight into the history of literary forgeries.

CHAPTER IV.

MODERN PERIOD.

1500—1600 A. D.

We have now arrived at what may be termed the modern period in Hindu chemistry and materia medica. The characteristic of this period is that over and above opium, we have some other foreign drugs incorporated into the materia medica. By the beginning of the 16th century A. D. the Portuguese had fairly established themselves at Goa and some other parts of India,* and as a result of intercourse with them, that dreadful scourge—the venereal disease—had made its appearance. Sanskrit medical treatises from the Charaka and Susruta downwards and ending with Śārṅgadhara are silent about this malady though they give fairly

* The political influence of the Portuguese as early as 1533 A. D. is evident from the fact that Sultan Bahadur, king of Gujarāta, entered into a treaty with them and through their assistance raised a force of 6,000 Abyssinians—"Memoirs of Humayun".

accurate descriptions of diseases of the genital organs (उपदंश). But syphilis had now to be reckoned with and a new name had to be coined for it. Accordingly we find *Rasapradīpa*, one of the standard works of this period given to Tantric method of treatment, prescribing calomel and *chobchini* (China root, *Smilax China*, Linn) for what is now termed for the first time *Phirangaroga* or the disease of the Portuguese. According to Flückiger and Hanbury "the use of this drug as a remedy for syphilis was made known to the Portuguese at Goa by Chinese traders about A. D. 1535." Thus from an independent source we can arrive at the approximate date of *Rasapradīpa*. This work also gives us a detailed process for the preparation of mineral acids by distillation which is here termed *samkhadrāvaka* (lit. a solvent for conch shells) and is described as "endowed with the property of dissolving metals." It is thus evident that the use of mineral acids as a solvent for metals was unknown in India before this time.* A very

* *Vide* Note on mineral acids, vol. i. p. 185.

noteworthy circumstance in connection with this is that the Bhāvaprakāsa, which is posterior to Rasapradīpa, is silent about sam-khadrávaka, which had come to be prescribed by this time as a favorite remedy for indigestion and derangement of liver and spleen; the solvents being borax, treacle, etc.—(cf. vol. i, p. 130). In the Bhāvaprakāsa among the acids we have only the juices of acid fruits. This is only another instance of the danger one is liable to incur by drawing inferences from *argumentum ex silentio*.

Rasakaumudī is another compilation belonging to this period and as far as its contents go it is comparable to Rasapradīpa in many respects; both opium and mineral acids are prescribed. From the colophon in the Calcutta Sanskrit College Library MS. we gather that the author is a physician named Mádha-va. Curiously enough he is often confounded with the celebrated Mádha-vakara, the author of the Nidánasamgraha, who preceded the former by some 8 or 9 hundred years.

The next work which should now claim our attention is the well known Bhāvaprakāsa of Bhāvamisra. It is a voluminous compilation in which the Ayurvedic method of treatment has been mainly adopted and as such ample citations are given from the Charaka, Susruta, Vāgbhata, Hārīta, Vrinda and Chakrapāni. But the Tantric remedies could not altogether be given a wide berth and accordingly one or two chapters have been devoted to mineral preparations; but these have been borrowed chiefly from Rasapradīpa, Rasendrachintāmaṇi, Sārṅgadhara and other standard works. Bhāvamisra has been scrupulously candid in his acknowledgments to the various authorities quoted by him. *Phirangaroga* is mentioned as also its treatment with the help of calomel and *chobchini*. The author lived about the time of the Emperor Akbar and evidently in that part of India which is now known as the United Provinces and it is not to be wondered at that Mussulman influence is discernible in his book.

We conclude our survey of this period

with the notice of a remarkable production entitled *Dhátukriyá* or "operations with metals"; it is in the shape of a dialogue between *Siva* and *párvati*; in short, it pretends to be a part and parcel of the *Rudrayámala Tantra*.* The work cannot be placed earlier than in the 16th century A.D., as it contains reference to the country of the *Phirangas* and to *Rúma*, the Arabic name for Constantinople. For the first time we come across the very appropriate term *dáhajala* (lit. burning water) coined to denote sulphuric acid. The information about the metals is of very meagre and poor description and it has been needlessly spun into an inordinate length. The author evidently considers it a pious fraud to make such statements as follow emanate from the mouth of *Siva* himself:—

"By using coins made of imitation gold one can carry on exchange . . . and thus enrich oneself."

* We have in hand transcripts of two MSS.—one from the Library of the *Mahárájá* of *Ulwar*, the other named somewhat differently, *Dhátumañjarí*, from *Benares*. They agree very closely.

The curious reader who is referred to the translations of the selected portions of the text given elsewhere will not fail to recollect similar passages in the Leyden Parchment where the dishonest goldsmith gives numerous recipes for "augmenting gold." * Fraudulent attempts in the direction of palming off alloys of base metals, possessing bright, yellow lustre, for gold, have been made in all ages and in all climes (*cf.* extracts from *Rasárnava*, Vol. i, p. 74).

Arkaprakāsa or a treatise on the preparation of medicinal tinctures and essences should also find a place here; † its authorship is ascribed to *Rávana*, the mythical king of Ceylon. The contents of the work, however, reveal its date. For instance, mercury, treated with *S'amkhadrávaka*, is prescribed as the remedy for "*Phiraṅgaroga*" (syphilis).

* Berthelot: "Collection des Alchimistes grecs" (trad. p. 287). "La Chimie au Moyen Âge," T. I. p. 31.

† There is a Calcutta edition published by *Gaṇeśa Chandra Ghoshā*; we have compared it with a MS. procured from the Sanskrit College, Benares. They agree remarkably well.

Opium also is prescribed ; while the term yasada is used to indicate zinc. As a distilling apparatus a tinned copper vessel is recommended. Mahommedan influence is distinctly discernible in this hybrid production. The very title of the book is no doubt Sanskritised from the Persian *arrak* (essence).

It is unnecessary to proceed further. We have before us the MSS. of Rasamañjari by Sâlinâtha, of Rasarañjana, of Gandhaka-kalpa (a Tantra), of Rasârṇava (quite distinct from the standard work bearing the same title), of Rasaratnâkara (altogether different from that of Nityanâtha) and several others. As all of these repeat *ad nauseam* the processes already described, we refrain from examining their contents here.

CHAPTER V.

INDIGENOUS ORIGIN OF INDIAN ALCHEMY.

The reader who has been able to follow us throughout with patience will not have been slow to recognise that alchemy in India has been developed all along on independent lines. Its origin and growth are interwoven with a phase of religious activity—the outcome of purely indigenous traits—which has been discussed at length in chapter i.

The only instance in which we find some allusion to adepts outside the pale of Hindu institutions occurs in *Rasaratnasamuchchaya*.^{*} But the term *Mlechchha* used there is a generic one applied indiscriminately to

^{*} *श्रेष्ठकसाधकान्*. *Vide* Vol. i, Sans. texts, p. 56; a variant in the Poona edition has *मेलकसाधकान्*, which must be rejected as both the Benares and Kármīr MSS. accept the former.

the Sakas, the Yavanas (Greeks or Bactrians), the Chīnas (Chinese), etc. The Hindus have never been shy of acknowledging their obligations to the Yavanas; Varāhamihira for instance expresses his admiration for the proficiency of the latter in the field of astronomy and would gladly learn at their feet.* In the Mahābhārata again we find the services of the Yavana architect, Purochana, requisitioned. We have not, however, come across a single passage, which may be construed into implying a hint to alchemists in the West. That the term Mlechchha in R.R.S. really refers to the Kirātas is evident from the colophon to Rasahridaya. †

Those scholars who have hitherto maintained that Indian alchemy is of exotic origin, have, we are afraid, done so on *a priori*

* खेच्छा हि यवनास्तेषु सम्यक् ब्राह्ममिदं स्थितं ।
अपि वस्तेऽपि पूज्यन्ते किं पुनर्देवा विद्मः ॥

† Sans. texts, p. 39; there the four castes (चतुर्वर्ण) are distinctly mentioned and the kirātas evidently included under the Mlechchhas.

grounds. Indeed the frame of mind which they have brought to bear upon this subject is not calculated to lead to a judicial and dispassionate verdict. The fact that the Hindus are indebted to the Greeks for substantial improvements in their astronomy is too often urged whenever it is necessary to support such a view.* There is, however, very little affinity in the mode of growth of alchemy in India and of its *congener* in the West. The progress of magic, witchcraft and alchemy can be traced from the Atharva-

* Cf.—“It was, however, Greek influence that first infused a real life into Indian astronomy. This occupies a much more important position in relation to it than has hitherto been supposed; and the fact that this is so, *eo ipso* implies that Greek influence affected other branches of literature as well, even though we may be unable at present directly to trace it elsewhere.” Weber: *Hist. Indian, Lit.* ed. 1892, p. 251. In justice to Weber, however, we should quote here his views on the independent origin of Hindu medicine; namely, “the weights and measures to be used by the physician are expressly enjoined to be either those employed in Magadha or those current in Kalinga; whence we may fairly presume that it was in those eastern provinces, which never come into close contact with the Greeks, that medicine received its special cultivation.”—p. 269.

vedas onwards to the later Tantras according to the laws of evolution without any breach of continuity.

One of the most favourite doctrines of the neo-Platonists was that the metals were engendered in the womb of the earth under the influence of the planets. According to Olympiodorus (5th century A. D.) lead is begotten by Saturn, "electrum"* by Jupiter, iron by Mars, copper by Venus, tin by Hermes, gold by the Sun and silver by the Moon. † Now, such a fascinating astrological belief was pre-eminently calculated to appeal to the Hindu instinct, especially as there was a "commercial and lively intellectual intercourse," to quote Weber's own words, between Alexandria and the West Coast of India. Varāhamihira's *Vrihatsam-*

* An alloy of gold and silver was known by this name. Later on it disappeared from the list of metals, tin being assigned to Jupiter, and mercury to Hermes.

† The influence of the astral bodies on the production of the metals can be traced to Proclus' commentary on the *Timæus*.—Berthelot: "*Les origines de l'Alchimie*:" p. 49; also *Coll. des. Alch. Grecs. trad.* p. 100.

hitá, if anything, is a repertory of astrological notions. In vain do we look even there for any such chance and solitary reference.* The alchemical literature of India is equally silent about it. † True it is there are two metals which are often designated as the sun and the moon respectively, namely copper

* Chapter xvi of this work treats of "countries, people and things belonging to the domain of each planet." Among sundry other things "the Sun is the lord of gold and fire." Thousand and one articles are said to be presided over by the Moon, Mars, Mercury, Jupiter, Saturn, Venus, Ráhu and Ketu; but nowhere is there any connection between the planets and the metals. *Vide* Kern's trans., pp. 97—101.

† The mythical origin of some metals is given in the *Paráwas*; but no reference to the astral bodies is to be found. Thus silver originated from the tears of the God Siva, copper from the semen of the God Kártikeya, lead from the semen of the Snake God Vāsuki, iron from the different parts of the body of the demons called Lomilas; and gold from the semen of the God of fire. Some vague and remote connection only can be established between this sort of nomenclature and that of the old Greco-Egyptian alchemists. According to the latter mercury is sometimes designated as the semen of Hermes; whilst in the *Tantras* it is the semen of Siva (इरवोज). *Vide* "Intro. a l'étude de la chimie des anciens," p. 11.

and silver.* But this has nothing to do with the planetary generation of these metals. In the imagery of the Sanskrit poet the crimson tint of the rising sun and the pale white lustre of the moon are comparable to the colour of copper and silver respectively.

The old Greek writers repeatedly refer to the mystic relationship between the seven planets and the seven metals. In the Sanskrit literature, however, beginning with the Susruta and coming onwards to Rasaratna-samuchchaya, we invariably find six metals recognised, alloys being rigorously excluded from the list and regarded simply as "artificially made." † It is only in the Sārṅga-dhara and other later works that we find seven metals enumerated ; ‡ but this author

* रवि, शुकं and other synonyms are as a rule applied to copper but rarely to gold.

† *Vide* Vol. i, pp. 48, 72 and 127.

‡ (चार) brass being taken as the additional metal ; zinc was evidently unknown to Sārṅga-dhara.

स्वर्णतारारताम्यादि नागवह्नौ च तौष्णिकम् ।

धातवः सप्त विज्ञेयाः ।

is guilty of a curious inconsistency, since in a subsequent part of his book he adds two more to the list and quietly lays down that there are nine metals, *which derive their names from the nine planets.** This may be read as a sort of vague and indistinct connection between the metals and the astral bodies.

The Arabs who adepted many of the Greek doctrines of alchemy also represented the seven metals by the seven planets. In fact it was through the medium of the Arabs

* "Kámsya" (bell-metal) and "Vrittalo" or "Vartalo" (cf.—Vol. i. p. 114) make up the number. Ráhu and Ketu are the two mythical planets; they are in reality the ascending and descending nodes in the ecliptic. Ráhu is supposed to cause the eclipse of the sun and the moon by swallowing it up.

Sáringadhara stops here, but his prolix commentator, A'dhamalla supplies the deficiency by making copper stand for the Sun, silver for the Moon, brass for the Mars, iron for Saturn, gold for Jupiter, tin for Venus, lead for Mercury and bell-metal and vartalo for Ráhu and Ketu respectively.

It will also be noticed that lead is here represented by Mercury; but in the Hindu alchemy mercury always stands as the visible manifestation of the God Siva, it being generated from his semen, hence the name हरवीज given to it.

and the Jews that a knowledge of the Greek sciences including alchemy filtered to the European nations during the middle ages.* We have already seen that Rájputána had been overrun and even occupied for a brief period by the Mussulman conquerors shortly before the time of Sárngadhara and it is reasonable to suppose that he had gleaned some astrological notions from that quarter.

We now advert for a moment to the main question of the connection of the comparatively modern and scientific phase of Hindu astronomy with the science of Alexandria. Although it is admitted by all those who are entitled to speak with authority on the subject that the Hindus borrowed from the Greeks and thus improved upon their older system, many points have yet to be cleared up. Professor Whitney who has

* "C'est par l'intermédiaire des écrits arabes et hébreux que la plupart des connaissances scientifiques des Grecs en mathématiques, en astronomie, en physique et en médecine, ont été transmises au moyen âge occidental : les écrits Grecs proprement dits n'ayant guère été connus directement avant la Renaissance."—"La chimie au Moyen Âge," T. i. p. 229.

carefully studied the subject is struck with the circumstance that the *Sūryya* and other *Siddhāntas* bear resemblance to the system of Hipparchus rather than that in the *Syntaxis*.^{*} In other words the transmittance of astronomical knowledge must have taken place before the time of Ptolemy. Now the period of lively intercourse is precisely that covered by the age of Ptolemy and that of his followers, and yet the Indian astronomers seem to be unaware of his teachings.[†]

* Intro. to "*Sūryyasiddhānta*". We find from Ptolemy that the observations of Hipparchus extended from B. C. 162 to B. C. 127. Ptolemy flourished at Alexandria in the second century A. D., under the reigns of Adrian and Marcus Aurelius.

This was also pointed out long ago by Colebrooke, *e. g.* "The whole cluster of astronomers mentioned by Brahma Gupta must be placed in the interval between the age of Hipparchus, and possibly that of Ptolemy."—*Essays*, pp. 411—412.

† A'ryabhatta composed his treatise "*Laghvāryabhattīyam*," in 496 A. D., and Varāhamihira his "*Pañchasiddhāntikā*" about 550 A. D. But these astronomers borrowed from the much older treatise entitled "*Romakasiddhānta*" ascribed to *Srīsenā*, and *Paulīśasiddhānta* (*vide* Thibaut' Intro. to *Pañchasiddhāntikā*, xxvii—xxxvi).

This mystery has never been elucidated ; Dr. Thibaut's arguments are ingenious, but, we are afraid, by no means convincing.* Indeed in the purely mathematical sciences the Hindus far excelled the Greeks of the Alexandrian school. A'ryabhatta's knowledge of algebra was superior to that of Diophantus and as for arithmetic it is generally acknowledged to be of Indian origin.†

The last word on the subject has yet to be said and it is doubtful if this dark recess will ever be illumined. In the meantime it would be better to hold our judgment in abeyance. At best we can only launch into hypotheses

* L. c., pp. li and liii.

† Cf.—Colebrooke : "Admitting the Hindu and Alexandrian authors to be nearly equally ancient, it must be conceded in favour of the Indian algebraist, that he was more advanced in the same."—Essays, ii, 429. Again, "in the whole science he [Diophantus] is very far behind the Hindu writers," *ibid.*, p. 438.

Kaye has recently questioned the priority of the claims of the Hindus : *Vide* J. A. S. B. iii [N. S.], July, 1907.

or indulge in dogmatic assertions.*

* One who approaches this subject should divest himself of prepossessions or the "bias of patriotism" as Herbert Spencer puts it. A very agreeable feature in this controversy is that those who are most competent to speak with authority are extremely modest, nay diffident [in giving expression to their views. Woepcke in his masterly memoir "on the propagation of the Indian numeral symbols" says :—"La solution parfaite de ces problèmes ne résulterait que d'une connaissance tellement complète des événements et de leurs phases, qu'il faut à peu près renoncer à jamais l'obtenir. D'un autre côté, remplir les vides par des hypothèses arbitraires au préconçues serait livrer l'histoire des sciences aux hasards et au dogmatisme des inspirations individuelles." "Journal Asiatique" (1863).

Lassen whose modesty is only equalled by his profound scholarship observes :—Es wäre sehr wünschenswerth, dafs ein mit der gehörigen Kenntnifs der Sanskritsprache ausgerüsteter Kenner der Mathematik und Astronomie es unternähme, aus diesen vorhandenen Hilfsmitteln die Lücken unserer Kenntnifs auf diesem Gebiet des Indischen Alterthums auszufüllen ; für jetzt müssen wir uns darauf beschränken, die hauptsächlichsten Ergebnisse der bisherigen Untersuchungen zusammenzustellen." "Indische Alterthums-kunde." Vol. ii. p. 1150 ; ed. 1874.

CHAPTER VI.

SOME NOTED INDIAN ALCHEMISTS AND THEIR WORKS.

Aufrecht in his notice of the MS. of *Rasaratnasamuchchaya*,* evidently from a mistaken notion that the pursuit of chemistry was unknown in ancient India, goes somewhat out of his way in asserting that the names of the 27 alchemists, mentioned in the beginning of that work,† are mostly apocryphal. We have, however, positive proofs that these personages far from being evolved out of the imagination of the author existed in real flesh and blood and contributed not a little to the progress of chemical science. Thus we read in *Rasaratnākara* of “chemical operations performed by *Māṇḍavya*” and also find *Ratnaghosha* taking part in a dialogue on certain processes, ‡ *Yasodhara*, again, is the author of the comprehensive work named *Rasaprakāśasudhākara*

* *Catalogus Catalogorum*, ii. p. 116.

† *Vide* Vol. i, p. 77.

‡ Eng. trans. pp. 6—8.

which we have noticed at some length in the present volume. Vyádi is a prominent name both as a grammarian as well as a chemist. The Garudapurána quotes him as an authority on gems.* Nandí, as we have already seen, is distinctly referred to by Somadeva as the inventor of the *koshtí* apparatus and of the process of sublimation. †

There are, indeed, a great many names scattered throughout the mass of chemical and medical literature, some of which have been handed down to posterity, sometimes on account of the important processes they invented and sometimes, again, because of the efficacy of the metallic preparations which they introduced. Thus in Rasendra-chintámani we come across the name of Siddha Lakshmísvara. The names of the sage Brahmajyoti, Manthánabhairava, Svachchhandahhairava and Gahanánandanátha have in this manner been rescued from oblivion. Most of these were Buddhist monks.

* व्याधिर्ज्ञेयाद् जगतां हि महाप्रभावः सिद्धी विदग्धचित्ततत्परया दयालुः ।

† Intro., lv.

Sivadāsa in his commentary on Chakrapāṇi quotes besides Patañjali, Bhavyadattadeva as an expert on iron preparations. We give below the names of some of the authors and their works over and above those already noticed. It is scarcely possible to submit an exhaustive list.

Name of the Author.	Name of the work.
Ānandānubhava	Rasadīpikā.
Balabhadra	(Unknown).
Bhojadeva	Rasarājamrigāṅka.
Chandrasena	Rasachandrodaya
Charpata	Charpatasiddhānta.
Dhanapati	Divyarasendrasāra.
Garudadattasiddha	Rasaratnāvali.
Gorakshanātha	Gorakshasamhitā.
(Unknown)	Bauddhasarvasva.
(Unknown)	Rasesvarasiddhānta.
Harihara	Rasavisvadarpana.
Kaṅkāli	Rasakaṅkāli
Kapāli	Rasarājamahodadhi.
Kesavadeva	Yogarātnākara.
Mallāri	Rasakautuka.
Narahari	Rasayogamuktāvali.
Rāmarāja	Rasaratnapradīpa.
(Siddha) Bhāskara	Rasendrabhāskara.
(Siddha) Prānanātha	Rasadīpa.
Śrīnātha	Rasaratna.
Trimallabhatta	Rasadarpana.
Vaidyarāja	Rasakashāyavaidyaka.
Vandimīra	Yogasudhānidhi.
Vāsudeva	Rasasarvesvara.

The Tantric Period

(Continued).

Chemistry in Rasaratnakara of Nagarjuna.

[In the rendering of Rasaratnākara of Nāgārjuna and other Sanskrit texts we have often given only free translations. Such passages as are unnecessary repetitions or are not of sufficient interest to the general student of the history of Chemistry have been left out.]

CHAPTER I.

I shall now speak of the purification of the important rasas* (minerals).

What wonder is it that rājāvarta digested with the juice of *Acacia sirisa* converts silver of the weight of one guṇja into one hundred times its weight of gold of the lustre of the rising sun ? 1

* Regarding rasas see Vol. 1, p. 79.

What wonder is it that yellow sulphur, purified with the juice of *Butea frondosa*, converts silver into gold when roasted thrice over the fire of cowdung cakes ? 2

What wonder is it that calamine.....roasted thrice with copper converts the latter into gold ?* 3

* These laconic recipes all refer to the floating mass of traditions current at the time of the author on the transmutation of the base metals into gold. As they are of a fragmentary and disjointed character, the meaning is not always clear. Recipe 3 also occurs in *Rasârṇava*; *vide* Vol. i, pp. 70-71. Various ingenious methods were resorted to for debasing gold or making an alloy, which would mimic the appearance of this metal. Silver, copper, lead, zinc and mercury were often made into an amalgam, and the latter rendered compact and coloured yellow with the aid of orpiment. No wonder that the law-books prescribe several penalties on the fraudulent debasers of the precious metals. Thus according to Manu "the king shall cause a goldsmith, who behaves dishonestly, the most noxious of all the thorns, to be cut to pieces with razors." IX, 292.

The reader who feels interest in this subject may consult Berthelot's "*La Chimie au moyen âge*," t. 1. pp. 31 *et seq.*, where will be found several recipes for augmenting gold *aurum plurimum facere*, or for the "fabrication of gold." One example may be cited here. "Take gold, copper and mercury, make an amalgam of the whole, afterwards add sulphur, orpiment, "sandarac" (a kind of resin) and the bile of the vulture &c." The author of the recipe thus concludes :—"Thou wilt now discover a secret, which is sacred and worthy of praise" (l. c. p. 35).

What wonder is it that cinnabar digested several times with the milk of the ewe and the acids* imparts to silver the lustre of gold glowing as saffron † 4

Digestion [of minerals] is to be effected in the decoction of *Dolichos uniflorus*, *Paspalum scrobiculatum*, the urine of man and the acid juices of [the fruit of] ratan (*Calamus rotang*) and afterwards with the addition of the alkalies (soda, borax &c.) The operation of roasting is to be performed thrice.—Cf. the process of Rasaratnasamuchchaya (R. R. S.), Bk. ii, 67-68 in Vol. i, p. 83.

What wonder is it that the pyrites macerated in the juice of *Musa sapientum* and in castor oil and clarified butter, and placed inside the bulb of *Arum campanulatum* and roasted [in a closed crucible] undergoes perfect purification ? † 6

Chapala and other minerals, being macerated in the juice of the lemon for 3 days, become purified. Gold being smeared with the 5 earths, the ashes and salts ‡ and roasted, undergoes purification. 12.

* Vegetable acids are meant here. *Vide* Vol. i, p. 128.

† Here extraction of copper from the pyrites is no doubt meant. Cf. R. R. S. Bk. ii, 89-90; *vide* Vol. i, p. 84.

‡ Cf. R. R. S. Bk. x, 71, 85; *vide* Vol. i, pp. 128-129.

Silver alloyed with lead and fused with ashes becomes purified.* 13

Lo | it is not to be wondered at that copper, melted with the alkali derived from the earth† and the milk of the ewe, clarified butter and one-sixteenth of its weight of oil, will become pure like the crescent of the moon. 14.

Verses 23-25 : Extraction of the essence of vaikrānta : exactly the same as in R. R. S. Bk. ii, 71-72. *Vide* Vol. i, pp. 83-84.

Verses 25-30 : Have reference to the extraction of copper from mākshika and tāpya (varieties of the pyrites). They agree in all essentials with Rasārnava, Ch. VII, 12-13. *Vide* Vol. i. p. 70

Verses 31-32 : Extraction of zinc from calamine. Cf. R. R. S. Bk. ii, 163-164. *Vide* Vol. i, p. 88.

Verses 35-36 : Exactly the same as in R. R. S. Bk. ii, 103-104. *Vide* Vol. i. p. 85.

Verse 37 : Essence of darada, i. e. extraction of mercury from cinnabar by distillation. Cf. R. R. S. Bk. i, 89-90. *Vide* Vol. i, p. 78.

* Refers to cupellation. Cf. Rasārnava in Vol. i, p. 68, footnote (1).

† पृथिवीभवेन चारेण may refer to natron or to saltpetre.

Verses 50-51 : Dissolution of gems (pearls &c.) by digestion in vegetable acids, *e. g.* sour gruel (impure vinegar) and the juice of certain acid plants.

* * * *

Here ends Chapter Second of Rasaratnākara by Nāgārjuna on the *killing* of diamond and the metals, extraction of the essence of minerals and liquefaction of mica.

CHAPTER III.

I shall now explain [the process of] fixation of mercury. The king of rasas (mercury), rubbed with the juice of lime, sal-ammoniac, the acids, the alkalis, the 5 salts, *Piper nigrum*, *P. longum*, the dried root of ginger, the juice of *Moringa pter.*, the tuber of *Amorphophallus campanulatus*, can readily amalgamate itself with the 8 metals. 1

* * * *

Prajñāpāramitā (perfection of wisdom) appeared before Nāgārjuna at midnight in a dream and revealed to him the ingredients of a recipe (consisting of steel, copper, mica, pyrites, &c.) 4

Mercury is to be rubbed with its equal weight of gold and then [the amalgam] further admixed with

sulphur, borax &c. The mixture is then to be transferred to a crucible and its lid put on and then submitted to gentle roasting. By partaking of this elixir (*i e.* the sublimate) the devotee acquires a body not liable to decay. 30-32

I shall now describe the Garbha yantram.* 62-65

Recipe for Kajjali or æthiops mineral,† 84-86

* * * *

Having made salutation to all the Buddhas, free from the taint of sins, I shall now deliver the Kakshaputa tantram ‡ for the benefit of suffering humanity.

[The most important part, from an historical point of view, is the dialogue between Nāgārjuna, King Sālivāhana and Ratnaghosha.]

Nāgārjuna, whose end (salvation) had been attained, benevolent towards all living creatures, blessed with all favours, residing on mount Śrīsaila, before him stood Ratnaghosha with folded arms,

* The same as in Rasārnava. *Vide* Vol. i, p. 66.

† The process is practically the same as in Chakrapāni; *vide* Vol. i, p. 58.

‡ There is extant a Tantra, which goes by this name, the reputed author of which is Nāgārjuna.

saying : "Be pleased to communicate to me knowledge on chemical operations."

Nāgārjuna said :—

Well done ! well done ! I am pleased with your devotion and shall convey to you all that you want to know, namely remedies for warding off wrinkles, grey hair and other signs of old age. Mineral preparations act with equal efficacy on the metals as on the body (human system). *

* * * *

For the benefit of living beings I went through all manner of penances for 12 tedious years and worshipped the goddess Yakshinī presiding over the *Ficus religiosa*. Then I heard an oracle.

Nāgārjuna said :—

O Goddess ! if thou art propitiated, be pleased to communicate to me the rare knowledge of the fixation of mercury.

* * * *

Sālivāhana said :—

I have dedicated to thee, O Goddess ! treasures of gold and gems, now I await thy instructions.

* This was a favourite metaphor with the alchemists. Cf. Vol. i, Intro. lxxvi.

The Goddess said :—

Well done ! well done ! O wise ruler ! I shall speak to you of chemical operations performed by Māṇḍavya.* ... A disciple should be intelligent, devoted to work, sinless, and master of his passions. †

The apparatus known as *koshtāi*, mouth blow-pipe, cow-dung, substantial wood* (as fuel), a pair of bellows, iron plates, * * * having collected all these, chemical operations are to be performed. ‡

Ratnaghosha said :—

Having prepared with great care “the powder of projection,” which transforms a ten million times its weight of the base metal into gold, § * * *

Nāgārjuna said :—

I shall convey to you what has been experimented upon by Sākāṇḍa. ¶

* A well-known alchemist ; one of the 27 adepts mentioned in the opening lines of R. R. S. *Vide* Vol. i, p. 77.

† Cf. “Initiation into discipleship” in Vol. i, p. 115.

‡ Cf. *Rasārṇava* in Vol. i, pp. 64-65.

§ कौटिल्यो मन्त्रारसः—the term वेद्यः has technical meaning. Cf. Vol. i, p. 120.

¶ We are unfamiliar with this name, probably the reading is corrupt.

Tests for *killed* mercury.

The first two couplets are almost the same as in Rasārṇava. Cf. Vol. i, p. 74.

When the quicksilver, which has acquired the colour and the lustre of the rising sun, stands the test of fire (*i. e.* is not readily volatilised), then it is to be regarded as *fixed*.

Here follows a list of apparatus borrowed from Rasendramangala—Detailed account of most of these will be found in R. R. S. Bk. ix. *Vide* Vol. i, p. 67.

**Chemistry in Rasahridaya
of Bhikshu Govinda.**

Quicksilver digested with sour gruel and then subjected to distillation is freed from [the impurities of] lead and tin. 1

Much the same as above. 2 • • • •

Description of the apparatus for purification of mercury by sublimation and distillation: it agrees almost literally with that given in R. R. S. Bk. ix, 6 8. *Vide* Vol. i, p. 121.

Pātala vii.

Ingredients for making a *vida* for killing metals. Cf. *Rasārṇava*, IX, 2-3. *Vide* Vol. i, p. 72.

Preparation of mild alkali from the ashes of plants :—

The process must be considered as a poor one, compared to the elaborate description in *Susruta*. Cf. Vol. i, p. 32.

Pātala viii.

* * * Alum, blue vitriol :—all these severally or collectively are favourable for imparting colour to quicksilver. *

Experts [on the properties] of metals are of opinion that tin gives strength, *tikshṇa* colour, lead unctuousness, copper all these qualities [to mercury.]

Couplets (in p. 29, Sans. texts) : The purport seems to be that when mercury is rubbed with certain sulphides, *e. g.* orpiment, pyrites &c., and sub-

* The text is not very intelligible. The other ingredients mentioned are *tikshṇa* and *kānta*, these being varieties of iron ; but iron will not amalgamate with mercury. *Tikshṇa* may also mean a kind of saline earth. The old alchemists racked their brains in devising ingenious processes for robbing mercury of its fluidity and imparting to it various colours. Cf. *Rasārṇava*, IX, 2-3, XI, 197-198. *Vide* Vol. i, p. 74 and also "The Hindu method of manufacturing calomel,"—*Ibid.* p. 250.

limed, it assumes the colour of lac or *Coccinella* insect (a poetical and figurative way of expression for red colour) in the shape of the red crystalline sulphide.

Pāṭala ix.

Vaikrānta, kānta, sasyaka, mākshika, vimala, adri, darada, rasaka :—these are the 8 rasas* and their essences are well suited for chemical operations.

Sulphur, gairika, kshiti, khechara (mica), añjana, kankushṭha :—these are the uparasas. Cf. Vol. i, p. 89.

Gold and silver are the *noble* metals.

Copper, brass, tīkshṇa and kānta (varieties of iron) are the essential or substantial metals; lead and tin emit foetid odours. Cf. Vol. i, p. 113, footnote (1).

The six salts are :—Sauvarchala, saindhava, chūlika (sal-ammoniac), sāmudra, romaka and vida. The alkalies are :—Sarjikākshāra, yavakshāra and borax. (*Vide* Vol. i, Index of subjects.)

Pāṭala xi.

A cupel made of boneash (goat's) and lined internally with borax &c.

* Cf. Vol. i, pp. 79-81.

Colophon giving an account of the author :—

Madanaratha, King of Kirāta, teacher of mercurial lore, in whom the Goddess of the science of mercury and minerals (Chemistry), the source of all good, has taken her abode for the benefit of mankind, who can restore to the disfigured patient, afflicted with leprosy, the healthy comeliness and lustre of youth :

Bhikshu Govinda, well versed in chemical operations and loaded with honours by the King of Kirāta, composed this tantra entitled "Rasahridaya."

This tantra is written by Govinda, the grandson of Maṅgalavishnu and son of Sumanovishnu :—
May Tathāgata pronounce his blessings.

Chemistry in Kakachandesvari- mata Tantra.

Pātala i.

The first *pātala* gives the origin (mythical) of the tantra.

Pātala ii.

Kākachandesvari said :—

• • • Please, give a brief account of the

Chemistry of the metals, the killing of mercury and minerals and the fusion of the gems. 3 4

Sri Bhairava said :—

• • • Mercury rubbed with the ingredients of the *vida* (see Vol. i, p. 72) and roasted in a closed crucible, is killed instantly. That mercury now acquires the power of converting a base metal into 1,000 times its weight of gold. 13-16

Copper, treated with the above preparation of mercury and rubbed with the acids, alkalies and the milky juice of *Calotropis gig.*, and roasted in a crucible, turns into gold. 18-20

Earth for making crucibles. 21-22 Cf. Vol. i, pp. 67-68.

Transmutation of iron into gold :—process not clear. 25-32

Pañala iii.

Liquefaction of mica :—

Thin plates of mica are to be smeared with the 3 alkalies and borax and strongly heated in a crucible. The whole mass fuses.* * * 29-30

* Refractory silicates are treated similarly at the present day with the "fusion mixture."

Chemistry in Rasendrachudamani of Somadeva.

Sans. texts, p. 51.

Tests for killed iron (rouge).

As R. R. S. has borrowed these from the present work, it is unnecessary to repeat them here. *Vide* Vol. i, pp. 118-119.

Sans. texts, pp. 52-53.

Take lead of the weight of 30 palas and rub it with the milky juice of *Calotropis gig.* and calcine it till its weight is reduced to a karsha: this residue, even if it be calcined a thousand times, will not undergo further decay (*i.e.* diminution in weight). Metallurgists call this residue derived from lead Chapala.*

Tin also similarly treated will yield a chapala, which, on merely being touched with the hand, kills (fixes) mercury. This mercury is recommended for metallurgical and not for chemical purposes.

* Possibly it refers to lead derived from *argentiferous galena*. The lead, being cupelled off in the shape of litharge, will leave a button of silver, which will not undergo oxidation.

Sans. texts, pp. 53- 4.

[A somewhat complex process described, which is not very clear. We shall try to give the purport thereof. The quantitative measurements are of particular interest.]

1 pala of tin should be taken and rubbed with 10 nishkas of mercury and made into a cake with the addition of zinc ;* it is then to be digested with the decoction of certain herbs and plants and warm vinegar and once more rubbed with $\frac{1}{2}$ pala of blue vitriol † and the juice of *Abrus precatorius*. The mass is then to be divided into small pills ; these should then be put into a crucible with the lid on and the fire to be urged by means of bellows. The essence is then to be taken out of the crucible. This essence of the weight of 10 *Sānas* is then to be enclosed in a mixture of ashes and salts and roasted. This essence of the weight of 2 nishkas is then to be fused with 80 times its weight of lead • • • . This (essence) is also termed chapala. Cf. "the gold-like alloy" in Vol. i, pp. 74 75.

* रसकस्य सस्त्रेन.

† पलाद्वैपद सस्त्रेन.

Sans. texts, p. 55.

When quicksilver has been deprived of its physical properties (lustre, fluidity &c.) it is known as *nash/apish/a*. Cf. Vol i, p. 74.

Somadeva will now give a brief account of the apparatuses, after having consulted numerous chemical tantras. (Here follows the description, which has been reproduced *verbatim* in R. R. S. *Vide* Vol. i, pp. 121 *et seq.*)

* * * *

Urddhvapātana apparatus as described by Nandin. Cf. Vol. i, pp. 124-125.

Koshtkī apparatus as described by Nandin. Cf. Vol. i, p. 69.

Chemistry in *Rasaparakasa-sudhakara* of *Yasodhara*.

Sans. texts, p. 57.

Preparation of *karpūrarasa* (lit. camphor of mercury, *i. e.* calomel) : practically the same process as given in Vol. i, pp. 250-51.

[Note. Calomel is prescribed here only as an aphrodisiac and a specific for leprosy but not as a remedy for syphilis.]

Sans. texts, pp 59-61.

Rasaka (calamine) : the author of R. R. S. has evidently borrowed his description of this mineral from the present work. Cf. Vol. i, p. 87.

Extraction of zinc from calamine :

(The process agrees almost word for word with what is given in R. R. S. The essence possessing the lustre of lead runs out of the crucible.*)

Sans. texts, pp. 61-62.

Saurāshṭrī or tuvarī (alum-earth) almost identical with R. R. S. Cf. Vol. i, p. 91.

* * * The essence extracted from the alums (i. e. oil of vitriol) is to be used for operations with metals and not as medicine.

Sans. texts, pp. 62-65.

[Descriptions of various kinds of pits for calcining and roasting purposes are given ; as also their dimensions with the number of cowdung-cakes to be used as fuel &c. Cf. the typical roasting pit in Vol. i, p. 127.]

* * * *

Here ends Chapter X of Rasaprakāśasudhākara by Yasodhara, son of Padmanābha.

* In R. R. S. we have "the essence possessing the lustre of tin."

Sans. texts, pp. 65-66.

Heinakriā or process for the fabrication of gold : "I shall now speak of some curiosities of metals, partly from my own experience and partly from the classics on the subject. Calamine, cinnabar, copper pyrites and realgar are to be rubbed with the milky juice of *Euphorbia neriifolia* for 7 days together and then to be digested another 3 days. Melted copper or silver or lead, being alloyed with the aforesaid mixture, acquires the power of converting 100 times its weight of base metal into gold."* Cf. *ante*, p. 2.

Chemistry in Rasachintamani Of Madanantadeva.

Sans. texts, p. 68.

Svetabhasma : Cf. *ante* p. 16 and also Vol. i, pp. 250-51.

Sans. texts, pp. 69-70.

Two processes for the fabrication of gold :—
much the same as already quoted from Yasodhara.

Process for the fabrication of silver :—

Take 1 part of bell-metal, 2 parts of silver, 4 parts of steel (?) * * these to be fused with

* ब्रह्मवेधो and सहस्रवेधो are technical terms ; for the meaning of वेध *vide* Vol. i, p. 120.

tin and borax ;—by this process will be made silver which will pass current for commercial purposes.

Sans. texts, p. 71.

Extraction of zinc from calamine :—

The process is much the same as given above (p. 17), with this difference that, whereas Yaso-dhara hits off the completion of reduction when the flame issuing from the pot ceases to be blue, the present author directs that the pot is to be taken out of the furnace as soon as white fumes begin to appear. The crucible is then to be held in an inclined position so that the lead-like essence of calamine drops on the ground.

Chemistry in Rasakalpa (Rudra - yamala Tantra.)

Bowing to Siva, the lord of mercury, and also the feet of Chandikā, I write this Rasakalpa, the depository of mercurial lore.

CHAPTER 1.

Tests for *killed* mercury :—

Killed mercury is that which is devoid of (metallic) lustre, not so ponderous, white,* des-

* The author previously refers to the red, black, white and even yellow ash (calx) of mercury ; it is not clear why he should

troyer of metals, divested of fluidity and non-volatile when stirred over a fire. 40 Cf. tests in Rasārnava in Vol. i, p. 74; as also in Rasaratnākara, *ante*, p. 9.

Purified mercury should be preserved in the hollow of a tooth or gem or bamboo. 42

CHAPTER II.

Gold, silver, copper, tin, lead and iron—these are the 6 metals; vartaloḥa, &c., (Vol. i, p. 114) are simply alloys. 1

Honest readers! I beseech you with folded arms to favour my book with your merciful glance.

The mahārasas are 8 in number; *e. g.* mercury, cinnabar, sasyaka, rasaka, &c. the rasas are mica, green vitriol and rājāvarta, &c. sulphur, orpiment and realgar, &c. are the uparasas as regarded by learned teachers. Cf. Vol. i, pp. 79 and 89.

There are 4 kinds of sulphur:—white, black, yellow and red. Cf. Vol. i, p. 90.

* * * *

here restrict himself to the white variety only. Chloride or sulphide of mercury, when treated with a metal and heated, *kills* (*i. e.* parts with its chlorine or sulphur to) the latter and in that sense it is a destroyer of metals लोहनाशक

The saurāshtris (alums) are of various kinds ; the kāsīsas (vitriols) are of 3 kinds,—namely, kāsīsa proper, pushpa kāsīsa and hīrakāsīsa.* Cf. Vol. i, p. 91.

Gairika is stated to be of 2 varieties,—the one of golden hue, the other red ; Kaṅkushṭha and other rasas are also described by certain teachers ; but these, however, are not referred to here; as we are treading in the footsteps of sages of old.†

Sans. texts, pp. 75-78

For the purification of mercury this process is recommended by Svachchhandabhairava and Govinda.

Chūlikalavana (Sal-ammoniac), sulphur and the ash of ginger, &c., digested one hundred times with cow's urine,.....make a vīḍa for killing gold. Cf. Vol. i, p. 72.

This process for killing [metals] was revealed by Siva and has been transmitted by successive schools of adepts.

* Hīrakāsa is the name by which green vitriol is known throughout India; Royle supposes that this word is derived from the Persian *hara* green, and Sans. kāsīsa. (Antiq. Hindu Med.) There is no necessity for looking upon hīrakāsa as a hybrid term, seeing that it occurs in the present work in which Mahomedan influence is nowhere traceable.

† Evidently Charaka and Susruta, who mention only a few commonly occurring minerals. *Vide* Vol. i, pp. 29 and 44.

Extraction of the essence of copper pyrites. Cf. Vol. i, pp. 70 and 84.

Extraction of zinc from calamine :—

The process is practically the same as given in R. R. S. Cf. Vol. i, pp. 87 88.

I have performed the [aforesaid] experiments with my own hands and have seen them with my own eyes. They are not recorded from mere hearsay or from the dictation of a teacher. These are being promulgated for the benefit of mankind.

Chemistry in Rasarajalakshmi of Vishnudeva.

Sans. texts, pp. 79-82.

Give an account of the common rasas and uparasas. Cf. Vol. i, p. 79.

Chemistry in Rasanakshatramalika of Mathanasimha, physician to the King of Malwa.

There are several prescriptions given in which mineral preparations play a conspicuous part. We have quoted only two; in the first, among other ingredients opium occurs; in the second, the

Svachchhandabbhairavarasa, probably named after the celebrated alchemist, we have the *calces* of tin, iron and mercury along with other drugs.

Chemistry in Basaratnakara of Nityanatha.

Sans. texts, pp. 84-86.

Test for *killed* mercury :—

When the substance, being heated over a fire of paddy husks, does not further decrease in weight, it should be considered as reduced to a calx.

Purified mercury should be stored in the hollow of a tooth or horn or bamboo.

Directions for making factitious cinnabar (Makaradhvaja). Cf. Vol. i, p. 132 (footnote).

Chemistry in Dhaturatnamala.

In the beginning the author after salutation says : "I shall speak of silver, gold, copper, lead, tin and iron as also of calamine, mica, pearls, coral, orpiment, realgar, the pyrites, mercury and diamond,—in fact, the properties of all the metals and minerals and the mode of their incineration."

Killing of silver. Cf. Vol. i, p. 107.

Chemistry in Rasapradīpa.

Description for preparing mineral acids by distillation:—"Sankhadrāvarasa or liquid for dissolving conchshells,—practically the same as given under "mineral acids" in Vol. i, p. 186. The last line says: "Cowrie-shells and metals dropped into the liquid are at once dissolved."

Preparation of calomel and treatment of "phiraṅgaroga" (syphilis) with its application. Cf. Vol. i, p. 252.

Chemistry in Dhātukriyā or Dhātumanjari (Rudrayamala tantra.)

Sans. texts, pp. 98 et seq.

Tin, iron and copper are to be classed among the superior metals.

In general a metal being alloyed with silver is improved in quality. Sattvaja metal (*i.e.* an alloy of tin and copper, *vide* below couplet 15) is of middle quality. 12-14

Synonyms of the different metals. 39-49

Synonyms of zinc: Jāsatva, Yasadāyaka,* rūpyabhrātā (lit. brother to silver), charmaka, kharpara, rasaka, &c. 50-51

* Yasada is the name commonly given to the metal extracted from calamine, *Vide* Vol. i, p. 156

Pittala is an alloy of copper and zinc. 63

Kāmsyaka is an alloy of tin and copper. 65

Zinc being amalgamated with mercury gives rise to rasaka. 68

[*N.B.*—Rasaka and kharpara are the names generally applied to the mineral calamine (*vide* Vol. i, p. 158), but here they stand for the metal (zinc) or its amalgam.]

Lead being killed with the aid of gentle heat gives rise to minium (red lead). 69

Copper in combination with the "burning water" gives rise to tuttha (green vitriol).—Thus manifold operations are performed with the aid of *mantras* and apparatus: all these belong to the province of Chemistry. 70-71

Synonyms of haritāla (orpiment): Orpiment is a consumer of mercury and also a clipper of its wings.* 79

Synonyms of realgar, cinnabar, mica, &c. 81-89

Synonyms of pearls, coral, tortoise-shell, conch.

* The sulphide of arsenic on being rubbed with mercury and gently heated converts the latter itself into the sulphide. The mercury is thereby *killed* and *fixed* i.e. deprived of its volatility (clipped of its wings—the Hindu alchemist's favourite figure).

shell, tusk of elephants, the tail of the peacock.
90-108

Localities for different metals. 113-121

[The information is very commonplace.]

Localities for copper specified : Nepāl, Kāmarūpa (the eastern portion of Assam), Bangala, † the country of the Mlechchhas, Rūma and the country of the Phirangas, &c. 143-145

Localities for zinc : Kāmboja, Rūma, Balkh, &c. 146

Metals in combination with mercury and sulphur become fit for administration as medicine. 153

• • • •

Process of roasting a substance in a stout glass-vessel using goat-and-cow-dung-cakes and husks of paddy grains as fuel. 9 10

One part of gold and four parts of zinc are to be melted together and the alloy roasted in a closed crucible . . . the process repeated with the addition of alkalies . . . gold of a reddish yellow colour will thus be generated. 11-17

* All these have been placed under the category of (हीन) inferior dhātu. Though the term dhātu generally means a metal, it is often applied to a mineral ; here, however, it covers a much wider field.

† This is the name given to Bengal in many Tantras.

A process for making factitious cinnabar by pouring mercury into its own weight of molten sulphur and then adding three-fourths its weight of orpiment The mass to be rubbed in a mortar and subjected to sublimation. 23-30

By using the *augmented** gold as a means of exchange one can amass wealth. 52

Tin is to be melted and one-hundredth part its weight of mercury to be amalgamated with it. This [fraudulent substitute for] silver can be used for purposes of exchange, and one can thus amass wealth. 85-86

Pure gold is to be alloyed with one hundred times its weight of copper and this [imitation] gold will resemble native gold. 88

Lead and copper being alloyed together will give rise to gold. 97-98

Colophon : Here ends the Chapter on the extolling of gold in Rudra-yāmala.

* Cf. footnote, p. 2.

Chemistry in Suvarnatāntra or Svarnatāntra.

The origin of the tantra is explained in the opening lines. Parasurāma having given away his worldly possessions to Kasyapa is rendered destitute, and thus has to invoke the aid of the God Siva for his very maintenance.

Siva said : Listen ! I shall now reveal to you the most wonderful mysteries of Svarnatāntra. 1-10

A kind of oil is exuded from the bulbous root of a plant ; all around it within a radius of ten cubits oily water is exuded and a venomous snake lives under it. If you want to test the properties of the bulb, you should thrust a needle into it, and the needle at once dissolves. Having procured this bulb, rub it with mercury in a mortar and add the oil and subject the mixture to heat in a crucible. The mercury is at once *killed* and acquires the property of converting one hundred thousand times its own weight of the base metal into gold.* I4-18

Pure orpiment is to be rubbed with this oil for 20 days, and the former is killed thereby and loses its volatility. The 8 metals in the molten state being treated with this prepared orpiment acquire

* लघवेधौ भवेत्.

the power of transmutation. When the above oil is thrown into molten copper, it is turned into gold of beautiful lustre. Tin and bell-metal similarly treated are turned into silver, and copper, iron, brass and silver into gold. 19-24.

Saṅkhadrāvaka (*aqua regia*, see *ante* p. 24) is spoken of as an universal solvent This solvent with mercury is to be placed in a glazed crucible and subjected to heat; the mercury, thus *killed*, can convert the 8 metals into gold. By partaking of this mercury one becomes immortal; even his urine and fæces can convert copper into gold.* 1-10

* This sort of belief was prevalent also at the time of the composition of *Rasārnava*.

Knowledge of Gems.

A few words on gems may not be considered beyond the scope of the present work especially as the subject has already drawn the attention of some European scholars.* We shall, however, limit ourselves, as far as possible, purely to the physical and chemical properties of the precious stones.

It has already been seen that among the 64 branches of arts and sciences recognised in the ancient 'Kāmasūtra' of Vātsyāyana occur the following :—(a) the testing [of the genuineness or otherwise] of gold and the gems ; (b) knowledge of the colouring of gems, as also of mines and quarries.† Varāhamihira (d. 587 A. D.) in his "Vrihat Samhitā" also conveys much useful information on this subject, but as he in his turn refers

* Garbe in his "Indischen Mineralien" (Leipzig, 1882) gives the text and the translation of Ch. xiii of Narahari's "Rājani-ghantu" ; this work, however, is comparatively modern. Much useful information on the subject with bibliographical references will be found in Professor Yogesa Chandra Rāy's treatise in Bengali entitled "Ratnaparikshā."

† *Vide* Vol. i, p. 191.

to experts who preceded him,* it may safely be concluded that long before this time it received adequate attention.

The *Garudapurāṇa* under the heading of *Ratnaparīkshā* (examination of the gems) devotes several chapters to a detailed and fairly exhaustive description of the gems. This *Purāṇa* like so many of its class discusses on a variety of topics, mundane and spiritual ; in short, it may be looked upon as a sort of *multum in parvo*.

From time immemorial the gems have been valued in India not only for purely decorative and ornamental purposes, but also as agents for warding off perils and the malignant influences of the planets and for securing luck and longevity. Hence it is that particular attention is paid to the testing of gems, as their virtue increases in proportion as they are faultless and flawless.

The typical characters which were most relied upon for differentiating one species of a gem from another were (1) the relative weight, (2) hardness, (3) lustre, transparency and colour, (4) fusibility, especially when heated in combination with the alkalis. It will be noticed that even the lapidaries

* पूर्वाचार्यैः समुद्दिष्टं

and the mineralogists of the present day have to depend largely upon these properties in the classification of the *stones*. We shall now proceed to say a few words under each of the above characters following in the main the authority of *Garudapurāṇa*.

1. **RELATIVE WEIGHT.** We have purposely used these terms as contradistinguished from "specific gravity": as the latter connotes peculiar associations. The principle of Archimedes being evidently unknown among the Hindus, the measurement of volume could only be roughly approximate. To cite some illustrations. A stone may be of the same species as, and equal in volume to, a *padmarāga* (oriental ruby), but will differ in weight from the latter.*

Empirical and arbitrary scales of weight were adopted as standards. A ruby occupying the volume of a *guñja* (*abrus precatorius*) may be equal in weight to 10. 7 and 3 *guñjas* respectively. A ruby of the volume of a *śrigālakola* (a kind of jujube) should weigh 12, 8 and 7 *guñjas* respectively. Again, a ruby of the volume of an *āmalakī* (*phyllanthus emblica*) should weigh 30. 20

* तुल्यप्रमाणस्य च तुल्यजातेषां वा सुदृढेन भवेत्तुल्यः ।

and 16 māsāhās respectively.* In each case the gem which is of greater weight is superior in quality and the value thereof is enhanced in proportion.†

In the case of precious metals, however, adulteration was detected by an ingenious device, which may be regarded as a near approach to the principle of Archimedes. Suppose it is intended to test the purity of a specimen of gold. All that one has to do is to draw a wire of this gold and another of the standard gold through the self-same orifice [of corundum]. As these wires are of equal

* We give below the standard weights as current at the time of Varāhamihira.

8	White mustards	...	=	1 tandula (a grain of paddy)
4	Tandulas	...	=	1 gunja (<i>abrus precatorius</i>)
5	Gunjas	...	=	1 Māshā
16	Māshās	...	=	1 Karsha or suvarna or tolaka
4	Karshas	...	=	1 pala

The standard of weight has always varied in different times in different parts of India. 10 gunjas weigh about 18 grains. The seeds often vary in size.

† Garuḍa lays special stress on the high specific gravity (= 4.0) of a genuine ruby. खद्युतं विज्ञातिखद्युतं, again गुरुत्वं सख्योर्ना गुणसंयुक्तः। While high specific gravity is indicative of the excellence of the gems in general, in the case of diamond it is just the reverse. गुरुता सर्वरत्नानां गौरवाधानकारणम् । वज्रं तन् वैपरीत्येन मूलतः परिचक्षते ॥ It is not easy to account for this qualifying clause, seeing that diamond has a sp. gr. of 3.5.

diameters, equal lengths will have equal weights, provided the sample is pure.*

2. **HARDNESS.** There are many stones which in external appearance resemble a ruby ; the spurious substitute may easily be detected by its difference in softness (low degree of hardness), and low specific gravity : again in case of suspicion the gem is to be rubbed on a whetstone ; if it simply gains in lustre but does not lose in weight (by abrasion), the specimen is to be regarded as genuine (test of a ruby).† Diamond and corundum alone will scratch ruby and sapphire. Skilful lapidaries often make imitation diamonds of zircon, ruby, cat's-eye, rock-crystal and glass ; hence they are to be tested by calling in the aid of learned experts. All the gems occurring in this world as also the metals will be scratched by a diamond, but the latter will not be similarly affected by the former.A diamond alone will scratch a diamond.‡

* एकच्छिद्रे समाकृष्टे समखण्डे इवीर्यदा ।

धालीः सूचं मानसमं निर्दुष्टस्य भवेत्तदा ॥ Sukracāṭi.

† This is true in a qualified sense only. After the diamond corundum is the hardest of all known minerals.

‡ The ruby and the sapphire are only varieties of corundum. Varāha classes corundum as a species of ruby, the former being dotted over with black and white patches and feeble in lustre [i.e. the non-transparent or coarse kind]. It is scarcely necessary to

To the above tests Rājanighanta adds another, namely, when a diamond is struck with an iron hammer, it is not broken to pieces*

point out that the very word "corundum" is derived from the Hindi *kurand*, a corrupt form of the Sanskrit *kuruvinda*. The statement "corundum will scratch ruby and sapphire" is not strictly accurate. There are degrees of hardness among the different varieties of corundum, the blue sapphire standing first in this respect.

We give here the original texts of which we have given above almost a literal translation.

"खेडप्रभेदो यदुता खड्गत्वं विजातिलिङ्गं खलु साध्वेजसम् ।"

"अप्रखण्डति सन्देहे शिलायां परिघटयित् ।

वृष्टा योऽत्यन्तशोभावान् परिमाणं न मुच्यति ।

स ज्ञेयः सहजातिस्तु ज्ञेयाद्यान्वे विजातयः ॥"

"वज्रं वा कुरुविन्दं वा विमुच्यान्वेन किञ्चित् ।

न शर्का लेखनं कर्तुं पद्मरामेन्द्रनीलयोः ॥"

* The reading of the text is very corrupt. Garbe gives as many as 12 variants; that adopted by him seems to be on the whole reliable as also his rendering: "Wenn er mit anderen steinen oder eisernen Hammern geschlagen nicht zerspringt." On account of its brittleness a diamond will readily be shivered into splinters under the blow of a hammer. The following extract from Bauer and Spencer's "Precious stones" (pp. 129-130) may prove of interest.—

"The hardness of diamond has often been confused with its frangibility or brittleness. It has been supposed, especially in ancient and mediaeval times that hammer and anvil may be shattered but not the diamond which lies between.

3. LUSTRE, TRANSPARENCY, COLOUR and other optical properties. Difference in lustre (जडप्रभेद) is often regarded as a diagnostic feature of the gems. According to Varāha gems of superior qualities should possess cool (lit. waxy) lustre, be limpid and emit rich rays. Classification according to colour is often enjoined. For instance, a diamond may be perfectly colourless, or it may be yellow,

This statement was made by Pliny, the great naturalist of ancient days, who was killed in 79 A.D. at the first historic eruption of Vesuvius. He proceeded to say further that the fragmentation of a diamond may be effected by subjecting it to a preliminary immersion in the warm blood of a goat, but that even under these circumstances the hammer and anvil will also be broken ! According to Albertus Magnus (1205-1280) the blood is more efficacious if the goat has previously drunk wine or eaten parsley.

“Such being the views then held respecting the unbreakable and indestructible character of the diamond, it is easy to understand why the Greek word *adamas*, signifying unconquerable, should have been applied to this stone, although its application to the diamond is singularly inappropriate and inaccurate when its extreme fragility is considered. Many a doubtful stone has been submitted to the test of the hammer, with the belief that the blow would be resisted only if the stone were a genuine diamond. Probably many beautiful stones have been sacrificed to this old belief. As a matter of fact, diamond is easily fractured, a very moderate blow from a hammer sufficing for the purpose ; its perfect cleavage places it among the most brittle of minerals.”

black, red or copper-tinted.* Stones which are translucent, opaque and of dull colour are inferior in quality. In the case of diamond special stress is laid on its displaying the colours of the rainbow [due to its high dispersive power]. Some gems have only one shade of colour (एकवर्णा) others again two (द्विवर्णा)†

The changes in colour which the ruby and the sapphire undergo under the influence of heat had evidently been carefully observed. This test is to be applied with extreme caution as in case the pro-

रक्तं पीतं दितं जैरीष (Varāha) वातासं (Garuda).

Yellow diamonds are unknown in India at the present day at any rate. "India can claim for its own all the finely coloured stones of blue, green and red, not however, yellow diamonds, which come mainly from South Africa." (Bauer and Spencer). Crystals of black diamond should not be confounded with the black carbonado.

† Probably refers to dichroism. As has already been pointed out the red ruby and the blue sapphire are only varieties of corundum, which often occur in well-developed crystals belonging to the rhombohedral division of the hexagonal system. "The dichroism of the ruby affords a means whereby it may be distinguished with certainty from other red stones, such as spinel and the different varieties of garnet, which crystallise in the cubic system, and thus being singly refracting can show no dichroism." (Bauer and Spencer). "The dichroism of the sapphires of Siam is specially well marked."—*Ibid.*

per degree of temperature अग्निमात्रा is exceeded, the stone may be materially injured.*

4. FUSIBILITY (LIQUEFACTION). It was well-known that all the gems with the exception of diamond would undergo liquefaction when strongly heated with a mixture of the two alkaline carbonates [now familiar in the Laboratory as the "fusion mixture"]. The liquid principle of gems रत्नजा द्रुति was a favourite remedy with the Hindu Iatro-Chemists (Cf. Vol. i, p 103). As most of the precious stones belong to the corundum and the spinel group, they easily yield to treatment with sodium and potassium carbonates. In the case of the pearls it is recommended that they should be enclosed inside lemons and placed in a mass of paddy grains [for the sake of the warmth].

* यावन्तं चक्रमेदसि पद्मरानीपथीमतः (?) ।

इन्द्रनीलमणिस्तस्मात् क्रमेत सुमहत्तरम् ॥

तद्यापि न परीचाये गुणानामभिज्ञये ।

मणिरथौ समाधेयः कथञ्चिदपि कथनम् ॥

अग्निमात्रा(ऽ)परिज्ञाने दाहदीर्घेष्ट दूषितः ।

सीलनार्थाय भवेद्भक्तुः कर्तुः कारयितुस्तथा ॥ Garuḍa.

Cf. "The red ruby, at a high temperature, is colourless : on cooling it first becomes green, after which it gradually assumes its original fine red colour." (Bauer and Spencer). "The blue colour of the sapphire disappears on heating."—*Ibid*.

GENERAL AND CONCLUDING REMARKS.

The crystalline character of the minerals is referred to in one or two places. All the old writers agree in describing the diamond as having 6 angles, 8 faces and 12 edges.* The octahedral form of the crystal is common in the diamond occurring in the neighbourhood of Panna in Bundel Khand. Rājānighānta further adds that the stone is often endowed with numerous faces and edges.† According to Rasaratnasamuchchaya the female diamond is flattened and rounded whilst the neuter is rounded and obtuse-angled‡ Vaikrānta is also

* कौट्यः पार्श्वानि धाराय वङ्कटी दाद्वयेति । Garuḍa.

† "In most cubes of diamond, however, each edge is replaced by two faces,.....the twenty-four faces thus derived would, if produced or enlarged" sufficiently, give rise to the form known as the four-faced cube, or tetrakis-hexahedron. (Bauer and Spencer).

‡ The rendering of the description of diamond in R.R.S. (vide Vol. i, p. 100) is based upon a misreading. The correct reading is that adopted by the Poona edition, namely, षट्पासं वाटफलकं षट्कोणं "a diamond has 8 faces and 6 angles." The author evidently uses षट्पास and फलक in the same sense; there cannot be any confusion here, as distinct mention is made of the 6 angles. As a rule षट्पास and कोण are used synonymously. Thus in Varāha वङ्क is described as वङ्कसि; the commentator Bhāṭṭotpālā explains it वङ्क भिरसिभिर्दुक्तं षट्कोणमित्यर्थः । "Rounded" (वङ्कुल); Cf. Bauer and Spencer. "The faces of diamond crystals differ from those of most other crystallised minerals, in that they are as a

(probably a mineral of the spinel group. *vide* Vol. i, p. 83) described as having 8 faces and 6 angles.

It is sometimes asserted that the phosphorescence of diamond was first observed in 1663 A. D. by the celebrated Robert Boyle. Bhoja (11th century A.D.), however, mentions this property.* Faults in precious stones due to isolated grains of minute gravels etc., embedded in the mass [now technically called "enclosures"], are also referred to.†

It may be noted here that what is generally known as the Indian or Tavernier's rule for determining the value of diamond can be traced back to a remote date. Sukranīti speaks of it as the "rule of squares,"‡ while Varāha, himself a great rule, much curved and rounded instead of being perfectly plane as is usually the case." p. 119. "Obtuse-angled" (कुण्डकोणाद्य) in the crystallographic terminology should be rendered as "with corners truncated off."

* अन्धकारे च दीप्यते (phosphoresces in the dark).

† कलुषा मन्दद्युतयो लिङ्गाकोणाः संधातवः खण्डाः ।

दुर्विद्या न मुनीनाः सशकंरायेति सविदोषाः ॥ Barāha.

Here संधातवः and सशकंराः no doubt refer of the minute pebbles (gravels) enclosed in the body of the stones.

‡ यथा सुवृत्तरं वज्रं तन्मूलं रत्नवर्गैः, i. e. if a diamond weighing 1 *ratī* be worth x , one of the weight of 4 *ratīs* will be worth $2 \times x$.

mathematician, gives practically the same rule, though somewhat on an elaborate scale.*

It would be unfair to compare the progress made by the Hindus in this branch of knowledge in the 6th century A.D. and perhaps earlier with that of the present day. Reference to the crystalline forms of diamond can be found in the writings of Keppler, Steno and Robert Boyle in the seventeenth century. Scientific crystallography originated with Romé de l'Isle and the abbé Haüy at the end of the eighteenth century. The various physical and chemical properties of the minerals culled here bespeak considerable powers of keen observation.†

i. e. if a diamond weighing 20 *tandulas* (p. 33 *ante*) be worth 2 lacs (2,00,000), one weighing 5 *tandulas* will be worth only ($5^2 \times 4 = 100$)th part of 2 lacs or 2,000.

† Concerning Ratnaparikshá cf. also "Les Lapidaires Indiens" by M. Finot in the "Bibliothèque de l'École des Hautes Études."



NOTE ON THE METHOD OF PREPARING CAUSTIC ALKALI.

In the first Volume of our History the detailed description of preparing caustic alkali from the ashes of plants has been quoted at length from the Susruta and we referred to it "as a proof of the high degree of perfection in scientific pharmacy achieved by the Hindus at an early age."* M. Berthelot has no less been struck with the originality of this process; indeed, he goes so far as to suggest that this portion in the Susruta is evidently modern and in fact a later addition derived from contact with the European chemists.†

The process of rendering mild alkali caustic by the addition of lime is to be found also in Chakrapāni (c. 1050 A. D.) and Vāgbhāta, who must have preceded the former by several centuries, and it is well known that both these authors are deeply indebted to the Susruta. There is not thus the remotest chance of inspiration from the European chemists.

* *Vide* Vol. i, Intro. c.

† *Journal des Savants*, Jan. 1903, p. 42.

We have evidence from quite an unexpected and independent source that the cauterization of bad wounds by means of caustic alkali was an established custom in ancient India. Thus we read in "The Questions of king Milinda" :—

"And when the inflammation had gone down, and the wound had become sweet, suppose he were then to cut into it with a lancet, and burn it with caustic. And when he had cauterized it, suppose he were to prescribe an alkaline wash Now tell me, O king ! would it be out of cruelty that the surgeon thus cut with the lancet and cauterized with the stick of caustic."*

* "Sacred Books of the East," Vol. XXXV, p. 168.

Although Milinda has been identified with the Bactrian Greek king Menander (c. 140—110 B. C.), it is not to be supposed that any Greek influence can be traced in it. In this ethical romance, king Milinda and the Buddhist Bhikṣu Nāgasena have been put forward simply "as men of straw" to quote Rhys Davids. The work in reality conveys the teachings of the older Buddhists (Hīnayānists) with the background of Sāṃkhya and Vedānta metaphysics.

The Tantrists, the Rosicrucians and the seekers after truth.

The East has not been always East and the West, West. Modern Europe is materialistic, but she has not disdained in the past to "plunge in thought." This reminds us of the truth of the poet's words: "one touch of nature makes the whole world kin." Ancient Greece had her orphic mysteries. They were developed into a religious and ethical system by Pythagoras. In the schools of Alexandria the neo-Pythagoreans and the neo-Platonists further added to it the Vedantic doctrine of a world-soul.

"With the dissolution of the neo-Platonic school in the sixth century, Greek philosophy disappears, it is true, as distinct phenomenon from the theatre of history, but it continues to exist in combination with foreign elements in the service of a new form of culture in the Science of the Middle Ages and of modern times." (Zeller).

Says Waite :—

"The traditions of the new-Platonic philosophy, with its elaborate theurgical system, were to some extent perpetuated through the whole period of the Middle Ages, for besides the orthodox theology of the great Latin Church and amidst the clamour of scholastic philosophy, we find the secret theosophy of the magician, the Kabbalist, and the alchemical adept borrowing, directly or indirectly, from this prolific

fountain of exalted mysticism. The traces of its influence are discoverable in Augustine, in Albertus Magnus, in St. Thomas, the angel of the schools, and in other shining lights of western Christendom, while the metaphysical principles of Johannes Scotus Erigena, even so early as the close of the ninth century, were an actual revival of this philosophy.*

History repeats itself. In India the Yoga doctrines of Patañjali paved the way for the origin of Tāntric mysticism and it associated itself with magic and alchemy. Some twelve centuries later, this phase in the stage of human progress found exponents in the soil of Europe. As Waite says :—

"In an age of progress, of doubt, and of great intellectual activity, it is singular to remark the almost invariable prevalence of mysticism in one or other of its manifold phases, and the close of the sixteenth century beheld spreading over the whole of Germany and passing thence into Denmark, France, England and Italy, a mighty school of mysticism in the great multitude of magicians, alchemists, &c., who directly or indirectly were followers of the renowned Paracelsus."†

*"History of the Rosicrucians," p. 27. Regarding the sect of the Cabalists see also Lecky's "Rationalism in Europe." Vol. i, p. 42. ed., 1900.

† See also Kopp's "Die Alchemie in alt. u. neu. Zeit," ii, pp. 1—146, on the "Bekanntschaft mit Geheimnissen der Magie, Theosophie, Alchemie u. A."

Even the lower strata of society in England did not escape the contagion. Sir William Temple observes : "I have had several servants far gone in divinity, others in poetry, have known in the families of some friends, a keeper deep in the Rosicrucian mysteries."

There are those who sneer at the attempts of the alchemists to convert the baser metals into gold and are at the pains to insinuate that the motives of the adepts were sordid. It may be that there have been here and there men—vulgar charlatans—who have pursued the *art* merely from worldly considerations. The high priests of alchemy, however have in every age and clime been honest seekers after truth. Had there been no desire implanted in the human breast to pry into the hidden and occult mysteries of nature there would have been no science. Whence come we and whither are we destined to go? What is this substance made up of, and what are its ultimate constituents, and what will its combination with this or that lead to? These are queries, the solution of which or rather the very attempts to solve which mark the birth of philosophy. Patañjali and Nāgārjuna in India and Paracelsus in Europe stand forth as the prominent representatives of

this spirit of inquiry. They have been dreamers, mystics and naturalists all combined in one. Such geniuses have always chafed at the restraints and limitations imposed on frail man and hence their fervid yearnings to peep into regions beyond the ken of our gross senses. As Emerson puts it :—

"The privilege of this class is an access to the secrets and structure of nature, by some higher method than by experience. In common parlance, what one man is said to learn by experience, a man of extraordinary sagacity is said, without experience, to divine."^{*}

Plotinus heaved a sigh at the soul with its infinite possibilities being caged in a frail and corruptible body. The pursuit of alchemy by the esoteric *Tāntrist* is easily explained. To him it was only a means to an end. "It (mercury) is alone that can make the body undecaying and immortal."[†] We find echoes of the same sentiment in the authoritative literature of the Rosicrucians,

Says Waite :—

"Among the concourse of inquirers, and the clamour of supposed and pretended discoverers, there rose gradually into deserved prominence an advanced school of illuminati,

^{*}"Swedenborg ; or, the mystic."

[†] *Vide* "History of Hindu Chemistry," Vol. I. Intro. lxxvii and xcv—xevi.

who, employing the terminology of the *turba philosophorum*, under the pretence of alchemical pursuits appear to have concealed a more exalted aim. . . . The student is directed by these writers from the pursuit of material gold to the discovery of incorruptible and purely spiritual treasures. . . . Physical transmutation, the one and supreme end of the practical alchemist, sinks into complete insignificance; nevertheless, it is performed by the adept and is a landmark in his sublime progress." l. c. p. 32.

The sage and seer of Hoenheim had his wrestlings. Should he pursue knowledge for its own sake or for what it bringeth? His evil genius holds out the bait thus :—

"Know not for knowing's sake
But to become a star to men for ever ;
Know for the gain it gets, the praise it brings,
The wonder it inspires, the love it breeds."*

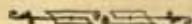
The spiritual at last triumphs over the base in man. Paracelsus has his revelation, and he bursts forth :—

"Truth is within ourselves : it takes no rise
From outward things, whate'er you may believe,
There is an inmost centre in us all
Where truth abides in fullness : and around
Wall upon wall, the gross flesh hems it in,
The perfect clear perception—which is truth."*

* Browning's "Paracelsus."

In the above delineation the poet has done no more than bare justice to the inward longings of an ideal alchemist, who is only an honest seeker after truth. The spiritual and thought-world has always transgressed all barriers of time and space. Kanāda, Patañjali and Nāgārjuna of India and Heraclitus, Empedocles and Plato and the rest—they all form a holy fraternity; aye, these prophets and oracles of the intellect belong to a "lofty and sequestered class," "the high-priesthood of the principles of thought from age to age. When at long intervals we turn over their abstruse pages, wonderful seems, the calm and grand air of these few, these great spiritual lords, who have walked in the world,—these of the old religion,—dwelling in a worship which makes the sanctities of Christianity look *parvenues* and popular; for 'persuasion is in soul, but necessity is in intellect.' "•

• Emerson : on "Intellect."





The metals and their loss in weight after calcination.

Very vague ideas prevailed among the Hindu philosophers on the constitutions of a metal and its fate after calcination. We are reminded of the diversity of opinion in Europe before the time of Lavoisier. A metal like every material substance was supposed to be formed of one or more of the five, bhūtas; in fact the earthy or saline element was taken to be predominant in it,* and hence it lent itself so readily to calcination. † It should be noted here that by "bhūta" was understood not so much an *element* in the modern connotation of the term as certain qualities of individual substances. Even mercury was regarded as composed of the five bhūtas. ‡ When a metal was submitted to calcination some of its component bhūtas escaped, leaving the earthy or saline portion behind; hence the ash (calx) must weigh less than the original metal itself

* पार्थिवाः सुवर्णरजतमणिमुक्तामनःशिलासूतकपालादयः । Ch. 1., 4. 2
Again in Ch. XLVI (Sūtra) 345 et seq. the metals are included among the saline ingredients.

† Cf. "For some maintain that gold is solid light, or, at least that the chief ingredient is light, which is rendered solid by mixture with some particles of earth. *Were it mere earth it might be calcined by fire strongly urged.*—Vol. 1. P. 9.

‡ पञ्चभूतात्मकः सृजतिष्ठत्येव सदाशिवः । इति रसायनं ।

There is, however, no direct reference to be met with anywhere as regards the quantitative aspect of the question so clearly established by Lavoisier.

The proportion of loss which a metal undergoes on ignition was made the basis for determining its purity and we find in the law-books an arbitrary scale fixed. Thus according to Yājñavalkya, "gold is unaffected by fire, while one hundred parts by weight of silver, tin and copper lose (lit. undergo decay to the extent of) two, eight and fifteen parts respectively.* This is to be taken as referring not to the roasting (killing) of a metal but simply as allowance made to goldsmiths and other artisans for loss incurred in the shape of dross &c. when it is melted in a crucible.

That copper, lead, tin and other base metals (लोहधातवः) when repeatedly calcined are completely reduced to their calces was well known as will be seen throughout the body of the texts. The passage from Rasendra-chūdāmani (p. 14) deserves some notice. Lead of the weight of 30 *palas* is to be calcined till its weight is reduced to a *karsha* ($=\frac{1}{4}$ *pala*). Even if it be calcined now one thousand times, it will not undergo further reduction in weight. Our author evidently had his experience of lead derived from argentiferous galena, which would leave

* अथो सुवर्णमक्षौण्णं विपलं रजते शते ।

अथो वपुषि-सीसि च तावत् पञ्चदशायसि ॥

a residue in the shape of a "button" of silver after the lead had been cupelled off. •

• Similar confusion prevailed in Europe up till the end of the 17th century. The following extract from Robert Boyle's "Concerning the Unsuccessfulness of Experiments" will make the point clear.

"Having, upon occasion, had the curiosity not long since to visit some mines of lead and other metals, I find that there is a great difference, and discernible even to the eye, betwixt the several ores ; for instance, of lead, some of which I can show you so like steel, and so unlike common lead-ore ; that the workmen upon that account are pleased to call it steel-ore, which being of more difficult fusion than ordinary, they are wont to mix it with other ore, which they call firm-ore, to facilitate the melting of it. And I likewise took notice of an ore, which for its aptness to vitrify, and serve the potters to glaze their earthen vessels, the miners call pottern-ore, and sell it (at least where I saw it digged up) dearer than other ore, from which it differs both visibly enough, and as the workmen affirm in divers other (and those less obvious) qualities ; and yet all these ores, after fusion, do pass indiscriminately under the name and notion of lead. In which therefore it is no wonder, that severer inquiries find a great deal of disparity. I remember I did not long since cause some lead-ore to be tried, which being the most promising that ever I saw, made me suppose it might contain some considerable quantity of silver : but though it proved so rich in lead, as to yield after the rate of seventy pound to the hundred, yet one of the most expert artists in Europe could not extract one grain of silver out of it ; whereas the lead of very many mines, being skilfully examined, will leave behind it, upon the test, a proportion of pure silver. And though this quantity of silver be not considerable enough to make such mines as yield it pass for silver mines

Antimony.

Although there is no direct recognition of antimony as a distinct metal, some sort of allusion to it as a variety of lead is not wanting. The reason why antimony was often confounded with lead is that at first sight stibnite may be mistaken for galena. The mineral *sauvīrāñjana* or *nīlāñjana* was thus indiscriminately applied both to the sulphides of antimony and of lead (cf. vol. 1., pp. 93-95). That *nīlāñjana* contained a new metal was often suspected though its nature was not properly understood. Thus in *Rasendra-chūdāmaṇi* we have "*nīlāñjana*, mined with *tikshṇa* (cast iron), and heated several times yields a superior kind of lead which is readily fusible and is of mild black colour. •

(or, as we are wont to call them mines-royal) because the silver will not quit the cost of extracting it ; yet such mines though they pass but for lead mines with the metalist, may appear to be mixt mines to the naturalist, who may meet with divers experiments, wherein the little silver that is in them, may make their lead operate differently from that of those ores, which are wholly destitute of silver."—Edition of 1772, p. 323.

* *Vide Sans. texts*, p. 52. The identical distich occurs also in R. R. S. Cf. vol. 1 p. 119. Cf. also "But to detain you no longer on the subject, give me only leave to strengthen the paradox I have proposed, by the authority of that great and candid chymist *Basilius Valentinus*, who speaking of antimony, after he hath told us, that there are several kinds of it, and especially two ; the one more mercurial and of a golden property, witnessed by the shining streaks or beams it abounds with ; the

The preparation known as Svarnasindura or makaradhvaja.

As the "law of definite proportion" was unknown to the ancients, tedious processes were resorted to for the complete conversion of mercury into its sulphide. "Makaradhvaja" even at the present day is a favourite remedy with the Hindu physicians of the A'yurvedic school.* Let us follow the recipe as given in Rasendra-chintāmani: "when quicksilver is killed with an equal weight of purified sulphur, it becomes hundred times more efficacious; when it is killed with twice its weight of sulphur it cures leprosy; when it is killed with thrice its weight of sulphur it cures mental langour; when it is killed with four times its weight of sulphur it removes grey hair and

other more full of sulphur, but destitute of the golden nature that enriches the former; adds, that there is such a different goodness betwixt the several sorts of antimony, as there is betwixt the several sorts of flesh or fish, which, though agreeing in name and, if you please, in nature, do exceedingly differ in point of goodness, which brings into my mind the great difference which I have found, even visible to the eye, betwixt the several sorts of Antimony."—Boyle's work—l.c. p. 324.

* If we take the historical meaning of the term "A'yurvedic," the above preparation cannot lay claim to this distinction, for it was unknown at the time of the Charaka and the Susruta and was introduced into the *Materia Medica* during the Tantric period.

wrinkles ; when it is killed with five times its weight of sulphur it cures consumption ; and when it is killed with six times its weight of sulphur it is a panacea for all the ills that flesh is heir to.* Now 25 parts by weight of mercury can only take up (*i. e.* combine with) 4 parts by weight of sulphur ; the excess of sulphur simply sublimes off unchanged. In the actual preparation of *svarna-sindūra* (Lit. vermilion with gold) the mercury is first made into an amalgam with thin gold leaves and then repeatedly rubbed in a mortar with sulphur. During the process of sublimation (ऊर्ध्वपातन) the excess of sulphur volatilises off as we have already explained and the gold in fine particles remains behind as a residue. The lustrous, crystalline, reddish brown sublimate, which collects nearest the source of heat,† has the formula HgS . As there is an erroneous impression about

- * तुल्ये तु गन्धके जीर्णे सङ्घातस्तृणो रसः ।
 द्विगुणे गन्धके जीर्णे सर्वकुष्ठहरः परः ॥
 त्रिगुणे गन्धके जीर्णे सर्वजायाविनाशनः ।
 चतुर्गुणे तत्र जीर्णे बलीपलितनाशनः ॥
 गन्धे पञ्चगुणे जीर्णे त्वदे चयदरी बलः ।
 षड्गुणे गन्धके जीर्णे सर्वरीगदरी रसः ॥ २, ३.

† Gopālakrishna very properly lays particular stress upon this point.

स्फोटयित्वा तु सुस्ताभमूर्द्धन्यं बलिं त्वजेत् ।
 अथः स रससिन्दुः सर्वरीगेषु योजयेत् ॥ इति रसेन्द्रसारसंग्रहः ।

the composition of this drug even among educated people in this country we give below the results of analysis of a sample of "mercury killed with six times its weight of sulphur along with gold."*

Identification of metals by their colouration of flames.

Prominent attention should be drawn to the following extract from *Rasārnava* (Vol. I., p. 68.)

"Copper yields a blue flame * * * *
that of the Tin is pigeon-coloured; that of the Lead is pale-tinted"

We are not aware of similar tests being applied anywhere at such an early period as a qualitative test for metals.

The age of Bhikshu Govinda the author of *Rasahridaya*.

There is a belief current in some parts of the Deccan that our Govinda is no other than the celebrated teacher of *Śaṅkarāchārya*. † If there be any historical foundation for the belief Govinda

* Percentage of sulphur found = 13.89; the calculated amount being 13.79; not a trace of gold could be detected.

† The following Slokas are cited from *Śaṅkaradigvijaya* in support of the above :—

तस्योपदर्शितवतश्चरयो मुखाया हरिः श्चपूजयदुपेत्य स प्रकरार्थः ।
आचार इत्युपदिदेश स तत्र तथै श्रीविन्दपादगुरवे स गुरुयंतोनाम् ॥

should no doubt be placed in the 8th century A. D. Apart altogether from the question whether at such an early date the progress of chemical knowledge as revealed in *Rasahrīdaya* had been attained in India, the colophon at the end of the work would tell against such an hypothesis (Intro. liii). The author distinctly states that he wrote his book under the auspices of the king of the *Kirātas* and even throws out a hint that he was of the Buddhist persuasion. We have no valid reasons to believe that *Saṅkara*, the sturdy champion of Brahminical faith and the mighty dialectician, whose activity proved the ruin of Buddhism in India should have sat at the feet of a Guru of the opposite creed.

व्यासः पराशरसुतः किल सत्यवत्या तस्यात्मजः शुकमुनिः प्रथितानुभावः ।
तच्छिष्यतामुपगतः किल गौडपादी गोविन्दनाथमुनिरस्य च शिष्यभूतः ॥
यथाव तस्य निकटे किल शास्त्रज्ञानं * * *

श्रीमच्छंकरदिग्विजयः, ५मसर्गः, verses १०१ and १०५-६ ।

आनन्दाश्रमसंस्कृतशब्दावलिः—शब्दाङ्कः २२ ।

In the above *Sloka* Govindanātha Muni is stated to be the preceptor of *Saṅkara*, the former being himself the pupil of Goudapāda, who in his turn was a pupil of Sukadeva, son of Vyasa, the well-known compiler of the Vedas. The Govindanātha of the text has been confounded by the commentator, Dhanapati Sūri with the Buddhist Govinda. It is scarcely necessary to take serious notice of the chronological perspective of the author of the *Saṅkaradigvijaya*.

The Mechanical, Physical and Chemical Theories of the Ancient Hindus.

(By Principal B. N. Seal.)

I propose in this paper to give a synoptic view of the mechanical, physical and chemical theories of the ancient Hindus. A chronological survey, even if the materials for it were available, would be here of little account. The origins of Hindu natural philosophy in the speculations of the Bráhmaṇas and the Upanishads, or in the mythology of the Purāṇas, however interesting from the standpoint of '*cultur-geschichte*,' do not come within the scope of the present exposition, which relates to the result of systematic thought as directed to the phenomena and processes of Nature. I have therefore confined myself to an account of natural philosophy as expounded in the principal systems of Hindu thought. The Sāṅkhya-Pātañjala system accounts for the Universe on principles of cosmic evolution, the Vaiśeṣika-Nyāya lays down the methodology of science, and elaborates the concepts of mechanics, physics and chemistry. The Vedānta, the Pūrva-Mīmāṃsā, and in a less degree, the Bauddha, the Jaina, and the Chārvāka systems, make incidental contributions on points of special interest, but their main value in this regard is critical and negative. The principal authorities

followed in this account,—the Vyāsa Bhāṣhya on Patañjali's sūtras, the Saṃhitā of Charaka, the Bhāṣhya of Prasastapāda, the Vārttika of Uddyotakara, and the Vrihat Saṃhitā of Varāhamihira,—all centre round the Hindu Renaissance, the beginnings of the anti-Buddhist reaction, in the fourth, fifth and sixth centuries of the Christian era. Whenever I have made use of later authors, *e. g.* Kumārila, Saṅkara, Śrīdhara, Vāchaspati, Udayana, Bhāskara, Jayanta, Varvara, Raghunātha, Vijñānabhikṣu &c.. I have taken care to see (except where the opposite is expressly mentioned) that no idea is surreptitiously introduced which is not explicitly contained in the earlier authors.

The Sāṅkhya-Pātañjala System.—This system possesses a unique interest in the history of thought as embodying the earliest clear and comprehensive account of the process of cosmic evolution, viewed not as a mere metaphysical speculation but as a scientific principle based on the conservation, the transformation, and the dissipation of Energy.

Prakṛiti—the ultimate ground:—The manifested world is traced in the Sāṅkhya to an unmanifested ground, Prakṛiti, which is conceived as formless and undifferentiated, limitless and ubiquitous, indestructible and undecaying, ungrounded and uncontrolled, without beginning and without end. But the unity of Prakṛiti is a mere abstraction; it is in reality an undifferentiated

manifold, an indeterminate infinite continuum of infinitesimal Reals. These Reals, termed *Gunas*, may by another abstraction be classed under three heads, (1) *Sattva*, the Essence which manifests itself in a phenomenon, and which is characterised by this tendency to manifestation, the Essence, in other words, which serves as the medium for the reflection of Intelligence, (2) *Rajas*, Energy, that which is efficient in a phenomenon, and is characterised by a tendency to do work, or overcome resistance, and (3) *Tamas*, mass or inertia, which counteracts the tendency of *Rajas* to do work, and of *Sattva* to conscious manifestation.

The ultimate factors of the Universe, then, are (1) Essence, or intelligence-stuff, (2) Energy, and (3) Matter, characterised by mass or inertia.

These *Gunas* are conceived to be Reals, substantive entities,—not however as self-subsistent or independent entities,—(प्रधान), but as interdependent moments in every Real or substantive Existence.

Even Energy is substantive in this sense. The infinitesimals of Energy do not possess inertia or gravity, and are not therefore material, but they possess quantum and extensity (परिमाण—परिच्छिन्न).

The very nature of Energy is to do work, to overcome resistance (रजस्यस्य उपपत्त्यर्थं), to produce motion. All Energy is therefore ultimately kinetic. Even potential Energy (बद्धवस्तुसंनिवृत्ति) is only the Energy of motion in imperceptible forms.

The original constituents and their interaction. Every phenomenon, it has been explained, consists of a three-fold *arche*, intelligible Essence, Energy, and Mass. In intimate union these enter into things as essential constitutive factors. The essence of a thing (*sattva*) is that by which it manifests itself to intelligence, and nothing exists without such manifestation in the Universe of Consciousness (समष्टिबुद्धि). But the Essence is only one of three moments. It does not possess mass or gravity, it neither offers resistance, nor does work. Next there is the element of *Tamas*, mass, inertia, matter-stuff, which offers resistance to motion as well as to conscious reflection. (तमः गुरु वरणकम्).

But the intelligence-stuff and the matter-stuff cannot do any work, and are devoid of productive activity in themselves. All work comes from *Rajas*, the principle of Energy, which overcomes the resistance of matter, and supplies even Intelligence with the Energy which it requires for its own work of conscious regulation and adaptation. (अन्त्यान्त्यान् अहङ्काराभ्यां स्वकार्योपजनने राजस्याहङ्कारः सहकारी भवति लोकाचार्य-तत्त्ववय-अभिप्रेतकः ।)

The *Gunas* are always uniting, separating, uniting again. (अन्त्यान्तिद्युताः सर्व्वं, नैषामादिसन्धयोगो विश्वो वा उपलभ्यते). Everything in the world results from their peculiar arrangement and combination. Varying quantities of Essence, Energy and Mass, in varied groupings, act on one another, and

through their mutual interaction and interdependence evolve from the indefinite or qualitatively indeterminate to the definite or qualitatively determinate. (एते गुणाः परस्परोपरकप्रविभागाः रूढयोगविभागधर्माः इतरितरोपाग्रहेण उपार्जितमूर्तयः ।—व्यासभाष्य). But though co-operating to produce the world of effects, these divers moments with divers tendencies never coalesce. In the phenomenal product whatever Energy there is is due to the element of Rajas, and Rajas alone ; all matter, resistance, stability is due to Tamas, and all conscious manifestation to Sattva, (परस्परव्यावृत्तिरपि असंभिन्नशक्तिप्रविभागाः—व्यासभाष्य । अन्ये व्यावृत्तिभावेन उत्पादितेऽपि द्रव्ये प्रकाशगुणः सत्त्वस्यैव क्रियागुणः रजस एव स्थितिगुणस्तमस एव—विज्ञानमिश्र योगवार्त्तिक on व्यासभाष्य, *ibid*—नेषां शक्तयः संकीर्यन्ते—वाचस्पतिमिश्र तत्त्ववैशारदी on व्यासभाष्य *ibid*)

The nature of the interaction is peculiar. In order that there may be evolution with transformation of Energy, there must be a disturbance of equilibrium, a preponderance of either Energy or Mass-resistance, or Essence over the other moments. The particular Guna which happens to be predominant in any phenomenon, becomes manifest in that phenomenon, and the others become latent, though their presence is inferred by their effect. For example, in any material system at rest, the Mass is patent, the Energy latent, and the conscious manifestation sub-latent. In a moving body, the Rajas, Energy, is predominant (kinetic), while the Mass or rather the Resistance

it offers is overcome. In the volitional consciousness accompanied with movement, the transformation of Energy (or work done by Rajas) goes hand in hand with the predominance of the conscious manifestation, while the matter-stuff or Mass, though latent, is to be inferred from the resistance overcome. (प्रधानवैलायाम् उपदमितनन्निधाना मुखत्वेऽपि च व्यापारमात्रेण प्रधानान्तर्नीतानुमितास्मिताः—व्यासभाष्य)

The starting point. The starting point in the cosmic history is a condition of equilibrium or equipoise consisting in a uniform diffusion of the Reals. The tendencies to conscious manifestation as well the powers of doing work are exactly counterbalanced by the resistances of the inertia or Mass. The process of cosmic evolution (परिणाम) is under arrest, (सत्त्वरजस्तमसां साम्यावस्था प्रकृतिः—Pravachana-Sūtra 61, Chap. I. साम्यावस्था अन्तर्नानतिरिक्तावस्था अन्तर्नाधिकभावेन असंघटावस्था अकार्यावस्था इति निष्कर्षः—विज्ञानभिक्षु, *ibid*).

Beginning of Evolution. The transcendental (non-mechanical) influence of the Purusha (the Absolute) puts an end to this arrest, and initiates the process of creation. Evolution begins with the disturbance of the original equilibrium. How this is mechanically brought about is not very clear. A modern expounder of the Sāṅkhya supposes that the particles of Sattva, Rajas, and Tamas possess a natural affinity for other particles of their own class, and that when the transcendental influence of the Purusha ends the state of arrest, the

affinity comes into play, breaks up the uniform diffusion, and leads to unequal aggregation, and therefore, to the relative preponderance of one or more of the three Gunas over the others. Thus commences formative combination among the Reals, and consequent productive activity. (*संज्ञनम् चारम्यकसंयोगः न्यूनाधिकभावेन चम्योर्न संयोगविशेषः* । Chap. I, Sūtra 66, प्रवचनभाष्य—विज्ञानभिषु । पृथिवीव्यक्तीनां पृथिवीत्वैव सत्त्वव्यक्तीनाम् एकजातीयतया एकता । स्वजातीयोपपत्त्यादिना इतिहासादिकं च युक्तम् *ibid.*, Sūtra 128, Chap. I).

Formation of wholes or systems—collocation of Reals :—Creative transformation accompanied with evolution of motion (परिच्यन्द) and work done by Energy (क्रिया) cannot take place without a peculiar collocation of the Reals (Gunas). To form wholes or systems (समुदय) it is essential that one Guna should for the moment be preponderant, and the others co-operant. And this cannot be without an unequal aggregation which overthrows the original equilibrium (गुणवैषम्य, न्यूनाधिकभाव),—in other words, without unequal forces or stresses coming into play in different parts of the system. (गुणविमर्श—वाचस्पति ।)
 व्यक्तं सक्रियं परिच्यन्दवत्.....समुदयः समवायः । स च गुणानां गुणप्रधान-
 भावमन्तरिण न सम्भवति । न गुणप्रधानभावी वैषम्यं विना । न च वैषम्य-
 मुपमर्शोपमर्शकभावाद्गते । (वाचस्पति, कौमुदी on káriká 16.)

The Formula of Evolution—Differentiation in Integration.—Evolution (परिणाम) in its formal aspect is defined as differentiation in the integrated (संसृष्ट-

विशेष). In other words, the process of Evolution consists in the development of the differentiated (वैदग्ध्य) within the undifferentiated (साम्यावस्था), of the determinate (निश्चय) within the indeterminate (अनिश्चय), of the coherent (युक्तसिद्ध) within the incoherent (अयुक्तसिद्ध). The evolutionary series is subject to a definite law which it cannot overstep (परिष्थानक्रमनियम). The order of succession is not from the whole to parts, nor from parts to the whole, — but ever from a relatively less differentiated, less determinate, less coherent whole to a relatively more differentiated, more determinate, more coherent whole. That the process of differentiation evolves out of homogeneity separate or unrelated parts, which are then integrated into a whole, and that this whole again breaks up by fresh differentiation into isolated factors for a subsequent reintegration, and so on *ad infinitum*, is a fundamental misconception of the course of material Evolution. That the antithesis stands over against the thesis, and that the synthesis supervenes and imposes unity *ab extra* on these two independent and mutually hostile moments is the same radical misconception as regards the dialectical form of cosmic development. On the Sāṅkhya view, increasing differentiation proceeds *pari passu* with increasing integration within the evolving whole, so that by this two-fold process what was an incoherent indeterminate homogeneous whole

evolves into a coherent determinate heterogeneous whole.

The different stadia in the order of cosmic Evolution are characterised as follows :—

- (1) The inconceivable, the unknowable, the formless, of which no character can be predicated (अविद्), including Prakriti, or the Reals in a state of equilibrium.
- (2) The knowable, the empirical universe, cosmic matter of Experience, things as matter or stuff of consciousness (विद्),—comprising Mahat, the intelligible Essence of the cosmos, evolved by differentiation and integration within the formless, characterless, inconceivable Prakriti.
- (3) Individuated but still indeterminate stuff bifurcating into two series—Subject-experience and Object-experience,—comprising on the one hand the indeterminate unity of apperception or the empirical Ego, as the co-ordinating principle of Subject-series (अविता), and on the other hand, the indeterminate material potencies, the subtle vehicles of potential Energy (तन्मात्र, सूक्ष्म), the ultimate subtle constituents of the Object-series (the material world). The previous stadium, the cosmic matter of Experience (विद्, मद्) evolves within itself,

by differentiation and integration, an individuated but still indeterminate stuff in two co-ordinated series, Subject and Object.

- (4) Determinate stuff (विशेष) evolved within the indeterminate by further differentiation and integration, viz., in the series of Subject-experience, sensory and motor stuff; and in the Object series, a corresponding atomic matter-stuff actualising the material potencies in the form of specific sensible Energies. The latter includes the different classes of Paramāṇus, the different kinds of atomic constituents of different kinds of gross matter (स्थूलभूत).
- (5) Coherent and integrated matter-stuff, individual substances, characterised by generic and specific properties, which however are not rigidly fixed, but fluent being subject to a three-fold change and constantly evolving, (अयुतसिद्धावयवभेदानुगतः समूहः द्रव्यमिति पतञ्जलिः—व्यासभाष्य, Sūtra 44, Chap. III. सामान्यविशेषसमुदायो द्रव्यं—व्यासभाष्य, *ibid.* सामान्यविशेषात्मा एतयोर्धर्मौ, *ibid.* धर्मैश्च धर्मैश्चत्वावस्थापरिणामः).
- (6) And so the cosmic series moves on in ascending stages of unstable equilibrium (विरुद्धव्यवस्थितपरिणाम) until the reverse course of equilibration and dissipation of Energy

(सहस्रपरिणाम and साक्षादवस्था) which even now constantly accompanies the evolution and transformation of Energy, completes the disintegration of the universe into its original unmanifested ground, the unknowable Prakriti.

The order of Cosmic Evolution according to the व्यासभाष्य (Sútra 19, Páda II) is shown below, in a tabular form :—

Prakriti, the unmanifested unknowable ground
(गूढमव्यक्तमलिङ्गं)

Cosmic matter of experience (महत्, लिङ्गं)

Subject series (बुद्धिशेष)	Object series
Individuated indeterminate mind-stuff	Individuated luminous determinate matter-stuff
(unity of apperception)	(subtile material potencies, तन्मात्र)
empirical Ego, बुद्धिज्ञाता	

Determinate mind-stuff	Determinate matter-stuff
(विशेष) sensory and motor psychoses, etc.	(विशेष) atomic and molecular constituents of gross matter
(ज्ञानेन्द्रिय, कर्मेन्द्रिय and मनः)	(परमाणु—सूक्ष्मभूत)

Coherent and integrated
matter-stuff (अयुतसिद्धावयवः
समूहः सङ्घातः द्रव्यं)

Individual substances,
with generic and specific
characters subject to con-
stant change or evolution
e.g. inorganic objects
composed of atoms or
molecules (परमाणु), vege-
table organisms (इव),
animal organisms (शरीर)
(अयुतसिद्धावयवः सङ्घातः शरीरं
इवः परमाणुरिति—व्यासभाष्य,
Sūtra 44, Pāda III).

तत्र तत् संसृष्टं विविच्यते क्रमान्ततः, तथा षड्विंशतिः लिङ्गमात्रे
संसृष्टा विविच्यन्ते, परिणामक्रमनियमात्, तथा तेषु अविशिष्टेषु भूतेन्द्रियाणि
संसृष्टानि विविच्यन्ते, न विशिष्टेभ्यः परं तत्त्वान्तरमस्ति तेषाम् भर्मानुसंधा-
नस्यापरिणामा व्याख्यायितव्यम् (व्यासभाष्य, Sūtra 19, Pāda II).

N.B.—The usual order given in the Sāṅkhya
compendiums is as follows :—Prakṛiti, Mahat,
Ahaṅkāra,—and then the bifurcation, *viz.*, 11 organs
sensory, motor and common sensori-motor from Rājasic
Ahaṅkāra, and Tanmātras from Tāmasic Ahaṅkāra,
—and finally the Paramāṇus of the Sthūla-Bhūtas.

The conservation of Energy (and of Mass)—the
transformation of Energy :—

The Guṇas (Reals), though assuming an infinite
diversity of forms and powers, can neither be created

nor destroyed. The totality of the Mass (Tamas), as well as of Energy (Rajas) remains constant, if we take account both of the manifested and the unmanifested, the actual and the potential. But the individual products of the evolutionary process, the concrete phenomenal modes resulting from the combined action of the original Mass, Energy and Essence, are subject to addition and subtraction, growth and decay, which are only due to changes of collocation, and consequent changes of state from the potential to the actual, (in other words, from the future to the present and from the present to the past, in a time series)—changes, which are illusorily ascribed to the Reals themselves. The different collocations of Mass and Energy give birth to the divers powers of things, the various forms of Energy which may be classed as like and unlike ; indeed the course of Evolution from the Reals conforms to a fixed law, not only as regards the order of succession, but also as regards the appearance (and mutual relations) of like and unlike Energies. And this transformation is constantly going on,—the course of Evolution is not arrested for a moment.

गुणान्तरं सर्वधर्मोत्पत्तिः न प्रत्यक्षमयन्ते नोपजायन्ते अक्षिभिरिव
चतुर्ताऽनागतव्ययमवतीर्तिः गुणान्तरिणीभिः उपजन्मापायधर्मका इव
प्रत्यक्षमासन्ते (व्यासभाष्य, Sūtra 19, Pāda II). परिणामिनित्यता
गुणानाम् । सर्वमिदं गुणानां सन्निवेशविशेषमात्रम् (*ibid.*, Sūtra
13, Pāda IV). एते गुणाः तुल्यजातीयानुल्लजातीयशक्तिभेदानुपत्तिनः
(*ibid.*, Sūtra 19, Pāda II). परिणामक्रमनियमात् (व्यासभाष्य,

Sūtra 19, Pāda II). कर्मान्तरं परिणामान्तरं हेतुः (*Patañjali* Sūtra 15, Pāda III). प्रकृतिः परिणमनशीला अणमप्यपरिणम्य नावतिष्ठते ।

The doctrine of Causation, a corollary from the conservation and transformation of Energy :—the principle of collocation—the storing-up and the liberation of Energy :—

The Sāṅkhya view of causation follows at once as a corollary from this doctrine of the conservation and transformation of Energy. As the total Energy remains the same, while the world is constantly evolving, cause and effect are only more or less evolved forms of the same ultimate Energy. The sum of effects exists in the sum of causes in a potential (or un-evolved) form. The grouping or collocation alone changes, and this brings on the manifestation of the latent powers of the Gunas but without creation of anything new. What is called the (material) cause or sum of material causes is only the power which is efficient in the production or rather the vehicle of the power. This power is the unmanifested (or potential) form of the Energy set free (उद्भूतशक्ति) in the effect. But the concomitant conditions are necessary to call forth the so-called material cause into activity. When the favourable combination or co-operation of concomitants is wanting, there is no manifestation of the effect. The question is—what is the aid which the concomitant conditions render to the deter-

mination (and production) of the effect existing in potency in its material cause ? First there is the merely mechanical view as illustrated by some commonplace examples, *e.g.*, the manifestation of the figure of the statue in the marble block by the causal efficiency of the sculptor's art, or of the oil in the sesamum by pressing, or of the grain of rice out of the paddy by the process of husking. In these cases the manifestation of an effect is only its passage from potentiality to actuality, a stadium in the process of evolution from possible (future) existence to actual (present) existence ; and the concomitant condition (सहकारिशक्ति) or efficient cause (निमित्तकारण), the sculptor's chiselling, the pressing, the husking, is a sort of mechanical or instrumental help to this passage or transition. कार्यशक्तिमत्त्वमेव उत्पादान-कारणत्वम् । सा शक्तिः कार्यस्य अनागतावस्था एव । स एव विशेषः (उत्पत्तेः प्राक् कारणे विशेषः) अस्माभिः कार्यस्य अनागतावस्था इत्युच्यते (विज्ञानभिद्यु-प्रवचनभाष्य, Sūtra 115, Chap. I). अभिव्यक्तिः वर्तमानावस्था । कारणव्यापारीदृशं कार्यस्य वर्तमानलक्ष्यपरिणाममेव जनयति । यथा शिलामध्यस्थप्रतिमायाः लेट्टिक-व्यापारीय अभिव्यक्तिमात्रं तिलस्यतेलस्य च निष्पीडनेन धान्यस्यतण्डुलस्य च अवघातेन (विज्ञानभिद्यु-प्रवचनभाष्य, Sūtra 129, Chap. I).

These mechanical examples of the Kapila-Sāṅkhya have the merit of simplicity, but the Patañjali-Sāṅkhya brushes them aside, and explains causation on the basis of the conservation and transformation of Energy, advancing it as the liberation of potential Energy existing

stored up in a Guna collocation, (the sum of material causes) the liberation following on the action of the proximate efficient cause, or concomitant condition (निमित्तकारण).

The causal operation of concomitant conditions (efficient causes) lies only in this that they supply a physical stimulus which liberates the potential Energy stored-up in a given collocation. Everything in the phenomenal world is but a special collocation of the ultimate Reals (Energy, Mass and Essence). The sum of (material) causes potentially contains the Energy manifested in the sum of effects; and in the passage from potency to actualisation, the effectuating condition (the concomitant cause) when it is itself accomplished, is only a step in the evolutionary series, which adds a specific stimulus, and renders determinate that which was previously indeterminate. When the effectuating condition is added to the sum of material conditions, in a given collocation, all that happens is that a stimulus is imparted, which removes the arrest, disturbs the relatively stable equilibrium, and brings on a liberation of Energy (उद्भूतइतिशक्तिः) together with a fresh collocation (गुणसन्निवेशविशेषः). सर्वमिदं गुणानां सन्निवेशविशेषमात्रम् इति परमार्थतो गुणात्मानः (व्यासभाष्य, Sūtra 13, Pāda IV); सततं फलस्य निमित्तं वर्तमानोक्तरीति समर्थे न अपूर्वोपजनने । सिद्धं निमित्तं नैमित्तिकस्य विशेषानुग्रहणं कुरुते । नापूर्वमुत्पादयति (व्यासभाष्य, Sūtra 12, Pāda IV).

Describing the production of bodies ('organic vehicles') for individual souls, out of matter of Prakriti, under the influence of their merit and demerit, as concomitant conditions, Patañjali points out that non-material concomitants like merit and demerit do not supply any moving force or Energy to the sum of material conditions, but only remove the arrest (the state of relatively stable equilibrium) in a given collocation, even as the owner of a field removes the barrier in flooding his field from a reservoir of water. This description is intended to represent the super-physical influence of non-material concomitants (or causes) like volition, merit and demerit, etc., but the causal operation of a material concomitant condition is essentially the same;—there is the same reservoir of stored-up Energy in a given collocation,—the same condition of arrest or relatively stable equilibrium,—the same liberation of the stored-up potential Energy which flows along the line of least resistance;—the only difference being that in the case of material concomitants the stimulus which removes the arrest is physical, instead of being transcendental as in the case of non-material causes like will, merit and demerit, etc.

The Vyāsa-bhāṣya helps us to a clear mental representation of the details of this process, being perhaps the finest example before Newton of the exercise of a Scientific Imagination, and as memor-

able as any in the whole history of thought containing as it does the theory of potentials as in a nutshell:—As the owner of many fields can irrigate, from a field which is already flooded, others of the same or a lower level, without forcing the waters thereto with his hands, and merely by making an opening in the barrier or dyke, on which the waters rush in by their own force ;—or further, as the same person cannot force these waters, or the earthy matters held in solution therein, into the roots of the rice plants, but only removes the obstructive grasses and weeds, on which the fluids of their own power enter the roots ;—such is the action of an effectuating condition (निमित्त) added to a sum of material causes or conditions.

निमित्तम् अप्रयोजकं प्रवृत्तीनां वरणभेदस्तु ततः शेषिकवत् (*Patañjali Sūtra 3, Pāda IV*). न हि चक्षोः निमित्तं यथा श्रेयिकः केदारान् अपां पुराणात् केदारं पिशाचविधुः समं निम्बं वा निम्बतरं वा नापः पाश्विनापकर्षति चावरणं तु चासां भिन्नं तस्मिन् भिन्ने स्वयमेवापः केदारान्तरम् आग्रावयन्ति ।

Chain of Causation—fixed order.—The order of Evolution with the transformation of the Energies follows a definite law. The unalterable chain of causes and effects in the phenomenal world illustrates this fixed order. But though the cosmic order is one and fixed, it comprehends divers series arising from different combinations of the original Gunas, which constitute subordinate or particular laws of cause and effect (क्रमान्वत् परिणामान्वत् हेतुः, *Patañjali Sūtra 15, Pāda III*).

What we call the qualities of things are only modes of Energy acting in those collocations. योग्यतावच्छिन्ना धर्मिणः शक्तिरिव धर्मः—स च फलप्रसवभेदानुमितसद्भावः (व्यासभाष्य, Sūtra 14, Pāda III). ते खल्वसौ धर्मो वर्तमाना व्यक्ता-
कानः, अतीताऽनागतः सृष्ट्यात्मानः सर्व्वेतिदं गुणानां सद्भिन्नशमावमिति परमार्थतो गुणात्मानः (व्यासभाष्य, Sūtra 3, Pāda IV). And these various Energies are sometimes actual (kinetic), sometimes potential, rising to actuality, and sometimes sublatent, subsiding from actuality into sublatency. In fact, the original Energy is one and ubiquitous, and everything therefore exists in everything else, *potentialiter* (सर्व्वं सर्व्वोत्पत्तिकमिति), without prejudice to the generic and specific differences of things (जात्यनुच्छेदेन सर्व्वं सर्व्वोत्पत्तिकं). Inorganic matter, vegetable organisms, and animal organisms are essentially and ultimately one (जलमृत्पौ-
षारिष्यामिकं रसादिदैवैरुच्यं स्वावरैश्च दृष्टं तथा स्वावराणां जङ्गमेषु जङ्गमानां स्वावरैश्च) so far as Mass and Energy are concerned, but the varied forms of Energy and the generic and specific qualities (or properties) of things, which are but modes of Energy, follow a definite unalterable law in the order of their appearance and succession, under conditions of space, time, mode and causality, and hence all effects do not manifest themselves at once दृशकालाकारनिमित्तापवन्नात् न खलु समानकालम् आकानामभिव्यक्तिः (ibid, Sūtra 14, Pāda III).
यो यस्य धर्मस्य समनन्तरी धर्मः स तस्य क्रमः। पिण्डः प्रपद्यते घट उपजायते इति धर्मपरिणामक्रमः। लक्ष्म्यापरिणामक्रमः घटस्य अनान्तभावात् वर्तमान-
भावक्रमः, तथा पिण्डस्य वर्तमानभावात् अतीतभावक्रमः (व्यासभाष्य, Sūtra 15, Pāda III).

Time, Space, and the Causal series :—

A Tanmātra (infra-atomic particle of subtile matter) is conceived by our understanding to stand in three relations—(1) position in Space (दिशावच्छिन्न), (2) position in the Time-series (कालावच्छिन्न) and (3) position in the causal series (निमित्तावच्छिन्न).

These three relations are the work of the intuitive stage of knowledge as opposed to the conceptual (निर्विकल्पप्रज्ञा as opposed to सविकल्पप्रज्ञा). But this is not the pure relationless intuition of Reality (निर्विचारा निर्विकल्पप्रज्ञा) which may be termed intellectual intuition, but the intuition that imposes its forms on the Real substrate (सविचारा निर्विकल्पप्रज्ञा) or in other words empirical intuition. तत्र भूतवृत्तेषु चमिष्यत्तदर्थेऽपि दिशकालनिमित्तानुभवावच्छिन्नेषु या समापत्तिः सा सविचारा इत्युच्यते । तथापि एकबुद्धिनिर्याणमेव उदितवर्गविशिष्टं भूतवृत्तमालम्बनोभूतं समाधिप्रज्ञायामुपतिष्ठते (व्यासभाष्य, Sūtra 44, Pāda I).

Infinite Time is a non-entity objectively considered, being only a construction of the Understanding (बुद्धिनिर्याण) based on the relation of antecedence and sequence in which the members of the phenomenal series are intuited to stand to one another. These phenomenal changes as intuited by us in the empirical consciousness fall into a series, which the Understanding conceives, as order in Time. The Time-series, then, is a *schema* of the Understanding for

representing the course of Evolution. The *schema* of the Understanding supervenes on the phenomenal world as order in time, and hence in the empirical consciousness the Time-series appears to have an objective reality, and to form a continuum. As there is an ultimate and irreducible unit of extensive quantity (परिमाणु) in the Gunas or infinitesimal Reals of Prakriti, which are without constituent parts, so the moment may be conceived as the ultimate and irreducible unit of this time-continuum as represented in the empirical consciousness. A moment therefore cannot be thought of as containing any parts standing in the relation of antecedence and sequence. If change is represented by the Time-series, a moment as the unit of time may be supposed to represent the unit of change. Now all physical change may be reduced to the motion of atoms in Space, and we may therefore define the moment as representing the ultimate unit of such change—*vis.*, the (instantaneous) transit of an atom (or rather a Tanmātra) from one point in Space to the next succeeding point. Even an atom has constituent parts (the Tanmātras). and hence an atom must take more than one moment to change its position. The motion of that which is absolutely simple and without parts from one point in Space to the next must be instantaneous, and conceived as the absolute unit of change

(and therefore of time, चण). If this is held to be an irreducible absolute unit, it will follow that what we represent as the time-contianuum is really discrete. Time is of one dimension. Two moments cannot co-exist. Neither does any series of moments exist in reality. Order in Time is nothing but the relation of antecedence and sequence, between the moment that is, and the moment that went just before. But only one moment, the present, exists. The future and the past have no meaning apart from potential and sublatent phenomena. One kind of transformation, to which a thing is subject, is that it changes from the potential to the actual, and from the actual to the sublatent. This may be called the change of mark (लक्षणापरिणाम) as opposed to change of quality (धर्मपरिणाम), and the change due to duration or lapse of time (अवस्थापरिणाम). The present is the mark of actuality,—the future, the mark of potentiality,—and the past, of sublatency,—in a phenomenon. Only one single moment is actual, and the whole Universe evolves in that one single moment. The rest is but potential or sublatent.

अणतत्क्रमयोगीति वस्तुसमाहार इति बुद्धिसमाहारः मुहूर्तादीरावादयः । स खल्वयं कालः वस्तुस्थौ बुद्धिनिर्माणः शब्दज्ञानानुपाती लौकिकानां व्यक्तितद्दर्शनानां वस्तुस्वरूप इव अवभासते । अणस्तु वस्तुपतितक्रमावलम्बी । क्रमयश्चणानन्यार्थात्मा । तं कालविदः काल इति आश्चर्यते योगिनः । न च हो अणौ सृष्ट भवतः, क्रमय न द्वयोः सृष्टुमीरसम्भवात् पूर्वोत्तरभावितो यदाननर्थे अणस्य स क्रमः । तस्मात् वर्तमान एवैकः अणः न पूर्वोत्तराणां

सन्तीति तस्माद्वाच्यं तत्समाहारः । यी तु भूतभाविनः चक्षुः ते परिणामान्विता व्याख्येयाः । तेनैकेन चक्षेन कृतस्यो लोकाः परिणामसमुभवति, तत्क्षणादुदाः सत्त्वमी धन्याः । यथाऽपकर्षपर्यन्तं द्रव्यं परमाणुः एवं परमाणुपर्यन्तः कालः क्षणः । यावता वा समयेन क्षणितः परमाणुः पूर्वदेशं जह्यात् उत्तरदेशम् उपसम्पद्येत स कालः क्षणः, तत्प्रवाहाविच्छेदस्तु क्रमः । (व्यासभाष्य Sutra 52, Pada III.)

Vijñāna-bhikṣu points out that this does not amount to a denial of Time. It means that time has no real (or objective) existence apart from the 'moment'. But the latter is real, being identical with the unit of change in phenomena (गुणपरिणामस्य क्षणत्ववचनात्). But even this is real only for our empirical (relative) consciousness (व्युत्थितदर्शन), which intuits the relation of antecedence and sequence into the evolving Reals (Gunas), in the stage of 'empirical intuition' (सर्विचारा निर्बिकल्पप्रज्ञा). The 'intellectual intuition' (निर्विचारा निर्बिकल्पप्रज्ञा) on the other hand, apprehends the Reals as they are, without the empirical imported relations of Space, Time and Causality.

Space as extension and Space as position :—

Space must be distinguished as *Desa* (locus, or rather extension) and *Dik* (relative position). Space (*Dik*) as the totality of position, or as an order of co-existent points, is wholly relative to the Understanding, like order in time, being constructed on the basis of relations of position intuited by our empirical (or relative) consciousness. But there is this difference between Space-order and Time-order :—there is no unit of Space as position (*Dik*),

though we may conceive a unit of Time, viz., the moment (क्षण) regarded as the unit of change in the phenomenal or causal series (परमावृत्तिश्च or गुणपरिणामस्य क्षणत्ववचनात्—योगवार्त्तिक, Sutra 51, Pada III). Spatial position (Dik) results only from the different relations in which the all-pervasive A'kāśa stands to the various finite (or bounded) objects. On the other hand, Space as extension or locus of a finite body, Desa (देशः स्थित्याधारः), has an ultimate unit, being analysable into the infinitesimal extensive quantity inherent in the Reals (Gunas) of Prakṛiti. (गुणप्रकृतेरक्षणपरिणामः—योगवार्त्तिक). एतेन नित्या दिगपि अप्रामाणिकी व्याख्याता, सामान्यतो दिग्व्यवहारमावात्। पूर्वादिद्व्यवहारस्य दिगुपाधिमिरिव सम्भवात् सामान्यतः कालदिग्व्यवहारसत्त्वेऽपि आकाशादेव तदुपपत्तेः। कालाच्च दिग्मये विशेषः यत् कालः क्षणरूप इत्यन्ते, दिक् तु सर्वदेव नित्यते।

The Casual series.—The relation of Cause and Effect has been already explained. It only remains to add that the category of causality is mediated through the *schema* of order in Time. The Empirical Intuition first superimposes relations of antecedence and sequence on changing phenomena (the evolving Gunas or Reals), and the Understanding out of these relations creates order in Time. The Empirical Intuition then intuits the phenomenal series of transformations of Energy in this Time-order and in so doing, imports the relation of cause and effect into the course of Nature. (कार्यकारणमावादीनां क्षणघटितत्वात्—योगवार्त्तिक, Sutra 51, Pada III).

The dissipation of Energy (and of Mass)—their dissolution into the formless Prakriti:—Cosmic Evolution (परिणाम) is a two-fold process, creative as well as destructive, dissimilative as well as assimilative, katabolic as well as anabolic (पशुजीमसर्ग and विजोमसर्ग, विसृष्टपरिणाम and सृष्टपरिणाम). In one aspect, there is the aggregation (unequal aggregation) of Mass and Energy, with consequent transformation of Energy, resulting in the creation of inorganic as well as organic matter, and the genesis of worlds. The successive steps of this process may be described as (1) unequal aggregation with storing-up of Energy in a certain collocation, under a state of arrest (i. e., in a state of relatively stable equilibrium), (2) a stimulus removing the arrest, and disturbing the equilibrium, and (3) liberation of the Energy, moving on to a fresh collocation, fresh aggregation, arrest and equilibrium. The process of the world thus moves on from equilibrium to equilibrium, and the result of that process is the development of a coherent determinate heterogeneous whole (लिङ्ग अविशेष विशेष, अयुतसिद्धावयवसमूह, युतसिद्धावयवसमूह) in what is essentially an incoherent indeterminate homogeneous whole (अलिङ्ग).

But there is a second aspect of this evolutionary process. Unequal aggregations are unstable, there is a constant tendency in things to go back to the original stable equilibrium,

the state of uniform equal diffusion of Reals. This process is called the resolution of like to like (सदृशपरिणाम), consisting in assimilation and dissipation, and being the exact opposite of the process of "differentiation in the integrated" which has evolved the Cosmos. The collocations of Mass, Energy and Essence are always breaking up, and the Energy as well as the Mass, however slowly, however imperceptibly, are being dissipated, i. e., dissolved into the original formless Prakṛiti, a state of permanent equilibrium and arrest, from which there is and can be no return, except under the transcendental influence of the Absolute at the commencement of a new creative cycle. Not that there is a destruction of the Mass or Energy, but a dissipation or dissolution into a condition of equal uniform diffusion from which there is no return. This is not the phenomenon of kinetic Energy disappearing and becoming potential or sublatent, for in such cases there is restitution or reconversion by natural means. When this reverse current of assimilation (and dissipation) prevails over the current of dissimilation (and integration), the Universe will disintegrate more and more, until it disappears in the formless Prakṛiti, its unknowable source and ground (तत्त्वव्यवस्था and कौमुदी).

The Evolution of matter (सांख्यविकसित) :—

The ultimate constitution of Matter is a question of the profoundest interest in the Sāṅkhya-Pātañ-

jala system. Three stages clearly stand out in the genesis of Matter :—(1) the original infinitesimal units of Mass or inertia, absolutely homogeneous and ubiquitous, on which Energy does work, when the original equilibrium comes to an end (भूतादि—तामसावधार). (2) The infra-atomic unit potentials, charged with different kinds of Energy, which result from the action of Energy on the original units of Mass, (तन्मात्र), and (3) the five different classes of atoms, the minutest divisions of which gross matter is capable, but which are themselves complex Tanmátric systems (सूक्ष्मभूतपरमाणु).

The first stadium Bhútádi is absolutely homogeneous and absolutely inert, being devoid of all physical and chemical characters (रूपादिभिरसंयुतं) except quantum or mass (परिच्छिन्नत्व. परिमाण); and this admits neither of addition nor of subtraction, can neither be created nor destroyed. The second stadium Tanmátra represents subtile matter, vibratory, impingent, radiant, etc., instinct with potential energy. These potentials arise from the unequal aggregation of the original mass-units in different proportions and collocations with an unequal distribution of the original Energy (Rajas). (तन्मात्ररूपादिः किं कारणम् इति चेत् सकारणद्रव्याणां न्यूनाविक्रमादेन यन्वीर्यं प्रति संयोगविशेष एव—स्रज्जातोद्योपटम्भादिना इन्द्रियासादिकं च युक्तं.) The Tanmátras possess something more than quantum of Mass and Energy. They possess physical characters, some of them penetrability

(अवकाशदान), others powers of impact or pressure, others radiant heat, others again capability of viscous and cohesive attraction. In intimate relation to these physical characters they also possess the potentials of the energies represented by sound, touch, colour, taste and smell, but being subtile matter they are devoid of the peculiar forms (विशेष) which these potentials assume in particles of gross matter like the atoms and their aggregates. In other words, the potentials lodged in subtile matter must undergo peculiar transformations by new groupings or collocations to be classed among sensory stimuli,—gross matter being supposed to be matter endowed with properties of the class of sensory stimuli, though in the minutest particles thereof the sensory stimuli may be infra-sensible (अतीन्द्रिय but not अनुद्भूत). (तत्त्वसंक्षिप्त-तन्मात्राः ते च अविशेषिणः । ते च पदार्थाः ज्ञानधोरमूदाख्यः सूक्ष्मत-शब्दादिविशेषेः शुद्धा एकरूपत्वात् । तथा च ज्ञानादिविशेषशून्यशब्दादि-मत्त्वमेव सूक्ष्माणां शब्दादितन्मात्रत्वम् ।)

The Tanmātras, then, are infra atomic particles charged with specific potential energies,—first, the potential of the sound stimulus is lodged in one class of particles, Tanmātras which possess the physical energy of vibration (परिचय) and serve to form the radicle of the ether atom (आकाशपरमाणु), then the potential of the tactile stimulus is lodged in another class of Tanmātras, particles which possess the physical

energy of impact or mechanical pressure in addition to that of vibration and serve to form the radicle of the gas atom (Vāyu Paramānu) ;—next, the potential of the colour stimulus is lodged in a third class of Tanmātras, particles which are charged with the energy of radiant heat and light in addition to those of impact and vibration and serve to form the nucleus of the light and heat corpuscle ; then the potential of the taste-stimulus is lodged in other Tanmātras, particles which possess the energy of viscous attraction, in addition to those of heat, impact and vibration, and which afterwards develop into the atom of water, and lastly, the potential of the smell-stimulus is lodged in a further class of Tamātras, particles which are charged with the energy of cohesive attraction, in addition to those of viscous attraction, heat, impact and vibration and which serve to form the radicle of the earth-atom.

पञ्चविंशतिः तद्यथा शब्दतन्मात्रं स्पर्शतन्मात्रं रूपतन्मात्रं रसतन्मात्रं गन्धतन्मात्रञ्च इत्येकविंशतिचतुष्टयसंज्ञयाः शब्दादयः पञ्चाविंशतिः । व्यासभाष्य.
Sutra 19 Pada II अहङ्कारात् शब्दतन्मात्रं तद्यथाहङ्कारसङ्कृतात् शब्दतन्मात्रात् शब्दस्पर्शगुणं स्पर्शतन्मात्रम् । एवंक्रमेण एकैकगुणहङ्कारा तन्मात्राणि उत्पद्यन्ते (व्यासभाष्य—Sutra 62, Chap. I).

शब्दादीनां मूर्तिसमानजातीयानाम् एकः परिणामः पृथिवीपरमाणुः तन्मात्रावयवः । भूतान्तरिषु अपि खेद्यैवाप्रणामित्वाऽवकाशदानानि उपादाय सामान्यम् एकविकारारम्भः समाप्तिः । (व्यासभाष्य, Sutra 14, Pada IV.) तद्यथा । गन्धतन्मात्रं वर्जयित्वा चतुस्तन्मात्राणां हेङ्गजातीयानाम्

एकः परिणामः अलपरमाणुः तेषां च महाजलादिः, एवं गन्धरसौ वर्ज्यं धित्वा
 श्रीचाजालीयानां चित्तान्वावाणां तज्जोऽणुः तैभ्यः महातज्जलादिः । एवं
 गन्धरसद्वपाणां वर्ज्यं नातु वायुणां तैभ्यः महावायुादिः । एवं शब्दतन्मात्रा-
 दहकारांश्च स्रज्जलात् वाकाशाणः तैभ्यः महावाकाशादिः ।

विज्ञानभिक्षु remarks :—एवं दर्शने अयं सिद्धान्तः शब्दादि-
 तन्मात्रपञ्चके काठिन्यसेहादिव्यङ्गाः पृथिवीत्वादिजातयः सन्ति । (योगवार्तिक,
 Sutra 14, Pada IV.)

Before explaining the genesis of atoms, it is necessary to say something about A'kāśa, which is the link between the infra-atomic particles (Tanmātras), and atoms (Paramānus). A'kāśa corresponds, in some respects to the ether of the physicists and in others to what may be called proto-atom (protyle). In one respect A'kāśa is all-pervasive (विष्णु), and devoid of the property of impenetrability which characterises even the infra-atomic potential units (Tanmātras). In another aspect, A'kāśa is described as having originated out of the mass or inertia in Prakṛiti (Bhūtādi) when the latter became charged with the first potential vibration (the sound-potential). Vijnāna-bhikṣu in the Yoga-Vārtika boldly tackles the difficulty. A'kāśa, he explains, has two forms, original and derivative. non-atomic and atomic. The original A'kāśa is the undifferentiated formless Tamas (mass in Prakṛiti, matter-rudiment—Bhūtādi) which is devoid of all potentials, and is merely the all-pervasive seat or vehicle of the ubiquitous original Energy (Rajas). This A'kāśa

must not be confounded with vacuum, which is merely negative (आवरणभाव—un-occupiedness), though it must be conceived as all pervasive, occupying the same space as the various forms of gross matter (समानदेशकम्—अवकाशस्वरूपम् आकाश—योगवार्त्तिक), and therefore devoid of the property of impenetrability (सूक्तान्तरासमानदेशत्वं—योगवार्त्तिक) which characterises atomic matter. But when the original equilibrium (साम्यावस्था) comes to an end, unequal aggregations form collocations in different groups and proportions of the three Gunas (तृणाधिकभावेन चतुर्विधं संयोगविशेषः संवृत्तम्—विज्ञानमिच्छु, प्रवचनभाष्य and योगवार्त्तिक).

The transformation of Energy now begins,—working on a collocation of mass (with Essence) (गुणान्तरीप-सम्बद्धं सद्देशतः—विज्ञानमिच्छु, योगवार्त्तिक); it first gives rise to the sound potential (शब्दजननयोग्याद्यैरूपेण परिणमति—विज्ञानमिच्छु) and the atomic A'kāśa (proto-atom, protyle) is but an integration of the original unit of mass charged with this vibration potential. This vibratory (or rather rotary) ether-atom (आकाशाणु) is integrated, limited (परिच्छिन्न) and as such cannot occupy the same space with other (subsequently integrated) atoms. But this proto-atomic integration of A'kāśa (काष्ठाकाश) is formed everywhere, and itself residing in the ubiquitous non-atomic A'kāśa (कारणकाश—अवकाशरूपमाकाश) forms the universal medium in which air or gas atoms, light and heat corpuscles, and other atoms move and float about. (वायोरवतरणं । यदि हि अवकाशरूपम् 'आकाशं

न स्यात् तदा मूर्तद्रव्येषु स्वाब्ध्यादिषु अन्तर्लोक्यादिविज्ञेयं न स्यात्—
विज्ञानमिच्छ, योगवार्त्तिक Sutra 40, Pada III. आकाशं हि
कार्यकारणरूपेण द्विविधम् । एत कारणाकारं तन्मीगुणविशेषतयेव
अवद्रियते । तदानीम् आकाशतात्पर्यशब्दकशब्दादिगुणविशेषाभावात् । तत्र
कारणाकारं गुणान्तरसम्बद्धं सन्देहतः आदौ शब्दजननयोग्यार्थरूपेण परिणमते
ततश्च अणुसङ्घातेन पृथिवीवर्द्धिव महाभूताकाशः अणुद्वारापेक्षया परिणमते
वायोरावरणम् उत्पद्यते (विज्ञानमिच्छ, योगवार्त्तिक, Sutra 41, Pada III).

*The genesis of the infra-atomic unit-potentials
(Tanmātras) and of the atoms.*

The subject of the genesis and the structure of the Tanmātras and the Paramānus was a fascinating one to these ancient thinkers, and a wide divergence of views prevailed. I will here notice several typical views :—those of the Vishnu Purāna, Parāsara, Patañjali and a certain School of Vedantists reported in the तत्त्वनिर्दिपण.

1. A famous passage in the Vishnu Purāna explains the genesis and the structure of the Tanmātras and of the Bhūtas (Paramānus) in the following manner :—

The first Tanmātra originated from the rudiment-matter (Bhūtādi), the individuated but still indeterminate potential-less Mass in Prakṛiti under the action of Energy (उपपद्यतः परिणमयन्ति—प्रवचनभाष्य, Sutra 66, Ch. I.) by a process of disintegration and emanation (विकृज्जाणः—विष्णुपुराण—एकविकारारम्भः—व्यासभाष्य, Sutra 14, Pada IV. विकारणभावः विकीर्णतासम्भावो व्याप्तिरिति

यावत्, योगवर्त्तिक on *Patañjali's* Sutra.—सनीजविन' विकरणभावः etc.) in the menstruum, or surrounding medium of the unindividuated Cosmic Mass (Mahat) (महतावतः).

This first subtile matter, the first result of 'Mass disintegration' and Energy-transformation, is charged with the sound-potential, the potential of vibration or oscillation (परिचन्द). It is called the sound-potential (शब्दतन्मात्र).

This is typical of the genesis (and structure) of the other Tanmātras (kinds of subtile matter). In each of the remaining cases, an atomic Mass charged with actual specific energies (भूतपरमाणु) disintegrates and emanates, and thus evolves a form of subtile matter (a kind of Tanmātra) under the action of Energy, and always in the same menstruum or surrounding medium,—that of Bhūtādi, the super-subtile. Each kind of subtile matter becomes charged with a new potential in addition to the potentials already evolved. The genesis of an atom, Bhūta-Paramānu, is a quite different process. Here the unit potential (Tanmātra) receives an accretion of Mass, and by a sort of condensation and collocation evolves an atom (Bhūta-Paramānu).

The genesis and structure of the Tanmātras and the Bhūta-Paramānus are worked out below :—

1. The super-subtile individuated Mass (rudiment-matter (Bhūtādi), under the action of the

original Energy (रजः) disintegrates and emanates (विकुर्वते) in the menstruum or surrounding medium (समावरण) of Mahat, cosmic super-subtile Mass, and evolves a form of subtile matter (तन्मात्र), which becomes charged with the sound-potential (vibration-potential, परिस्वन्द), and is called the unit of sound-potential (शब्दतन्मात्र).

2. This subtile matter, the Mass, charged with sound-potential, receives an accretion of Mass from the rudiment matter (Bhútádi) and by condensation and collocation evolves the A'kása Bhúta, the atomic A'kása, the proto-atom charged with the specific energy of the sound stimulus (actual vibratory motion.) (स एव सूक्ष्मदिः शब्द-तन्मात्रात् संहितोऽयम् शब्दगुणकम् आकाशं सस्रजं । तथा च अहङ्कारशब्दतन्मात्राभ्यां मिलित्वा आकाशं स्रज्यते,—योगवार्तिक on the Vishnu Purána passage, Sutra 14, Pada IV).
3. This proto-atom, the atomic A'kása, charged with its actual specific energy, again disintegrates and emanates, under the action of the original Energy, and in the menstruum of the rudiment-matter (super-subtile Mass) and thus evolves another kind of subtile matter (Tanmátra) which becomes charged with the touch-potential (the potential of impact or mechanical pressure

(प्रकाशित, दृश्यश्रील) in addition to the sound-potential (vibration-potential—परिस्पन्द) and is called the unit of touch-potential (स्पर्शतन्मात्र).

4. Next, this subtile matter, the mass charged with touch (and sound) potential, *i.e.*, with the potentials of vibration and impact, receives an accretion of mass again from the rudiment-matter (Bhútádi) and by condensation and collocation, evolves the Váyu Bhúta, a kind of gaseous matter or air of which the atoms are charged with the actual specific energy of the touch stimulus, *i.e.*, with actual energy of impact in addition to the actual energy of vibratory motion.
5. Next, the atom of Váyu, so charged with the actual specific energy of impact and vibration, again disintegrates and emanates, under the action of the original Energy, and in the same menstruum or surrounding medium of the rudiment matter (super-subtile Mass—Bhútádi) and thus evolves another kind of subtile matter (Tanmátra), which becomes charged with the heat-potential (बीजा—उद्—heat-and-light-potential) in addition to the impact-potential and the vibration-potential, and is called the unit of colour-potential (रूपतन्मात्र).

6. Now this subtile matter, this radiant matter, charged with light-and-heat-potential, and also with impact and vibration-potential, receives an accretion of Mass again from the rudiment-matter (Bhútádi), and by condensation and collocation evolves the Tejas Bhúta, the light-and-heat-corpuscle, which is charged with the specific Energy of the colour-stimulus, *i.e.*, radiates actual heat and light (फक्कित्थ) in addition to manifesting the energy of impact (impingency) and of vibration (or oscillation).
7. Next, this atom or light-and-heat-corpuscle disintegrates, and emanates as before a form of subtile matter charged with the taste-potential (रसतन्मात्र), in addition to the three potentials already generated, and also with the physical potential of viscous attraction.
8. This subtile matter charged with the taste-potential and with the potential of viscous attraction condenses and collocates as before into the water-atom which manifests the actual specific energies of viscous attraction and the taste-stimulus.
9. The viscous water-atom charged with the actual specific Energy of the taste stimulus disintegrates, and emanates as before a form of subtile matter charged with the

smell-potential in addition to the four potentials already generated and also with the potential of cohesive attraction.

10. This subtle matter charged with the smell-potential and with the potential of cohesive attraction condenses and collocates as before into the earth-atom, which manifests the actual specific Energies of cohesive attraction and the smell-stimulus.

Vijñāna bhikṣu in the Yoga-Vārtika briefly summarises the Viṣṇu Purāṇa process as follows :—

Bhūtādi as radicle in conjunction with Mahat produces the sound potential, which as radicle in conjunction with Bhūtādi produces A'kāśa, which as radicle in conjunction with Bhūtādi produces the touch-potential, which as radicle in conjunction with Bhūtādi produces Vāyu, which as radicle in conjunction with Bhūtādi produces the colour-potential, which as radicle in conjunction with Bhūtādi produces Tejas and so on.

In this brief summary he does not bring out the force of विकृत्वांशः (the disintegrating process), and the distinction between the genesis of subtle and gross matter (Tanmātra and Bhūta).

यदा प्रधानेन महान्, महता स तदावतः ।

भूतादिस्तु विकृत्वांशः सग्रे तन्मात्रिकं ततः ।

ससर्गं शब्दतन्मात्रात् आकाशं शब्दलक्षणम् ।

शब्दमात्रं तदाकाशं भूतादिः स समावृणोत् ।

आकाशस्तु विकृज्वाणः स्पर्शमात्रं ससर्गं च ।

बलवान् अभवत् वायुः तस्य स्पर्शो गुणो मतः । (विष्णुपुराण)

11. A famous passage in Parāśara takes another view of the genesis and structure of the Tanmātras and the Bhūta-Paramāṇus. Krishna-pāda, in the सत्त्ववयविवरण, represents the scheme as follows :—

The Tanmātras originate from one another in one linear series, and each Bhūta originates in a separate line from its own Tanmātra .—

भूतादि (Bhūtādi)

शब्दतन्मात्र	Sound-Tanmātra—as a radicle or centre surrounded or encircled by Bhūtādi generates A'kāśa.
स्पर्शतन्मात्र	Touch-Tanmātra—as a radicle or centre encircled by Sound-Tanmātra with A'kāśa-atom as a help generates Vāyu—
रूपतन्मात्र	Colour-Tanmātra—as a radicle or centre encircled by Touch-Tanmātra with Vāyu-atom as a help generates Tejas—
रसतन्मात्र	Taste-Tanmātra—as a radicle or centre encircled by Colour-Tanmātra with Tejas-atom as a help generates Ap—
गन्धतन्मात्र	Smell-Tanmātra—as a radicle or centre encircled by Taste-Tanmātra with Ap-atom as a help generates Prithivi.

The genesis of a Bhúta-Paramánu (atom) from the subtle matter of a Tanmátra is not here so simple as in the view of the Vishnu Purána. The latter speaks of condensation and collocation, but in the passage under reference a Tanmátra is supposed to act as a radicle, as the centre of a system, surrounded or encircled by Tanmátras of the immediately higher order in the medium of its own Bhúta.

Thus an atom of A'kása has the following structure :—



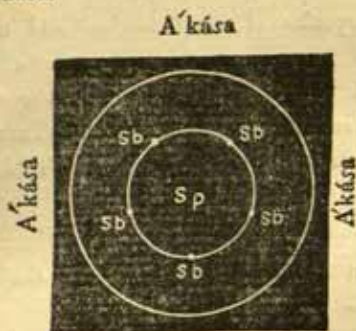
An atom of A'kása

Sb = S'abda-Tanmátra (vibration-potential)

Bh = (Bhútádi)

An atom of Váyu is constituted as follows :—

This takes place within the surrounding medium of A'kása.



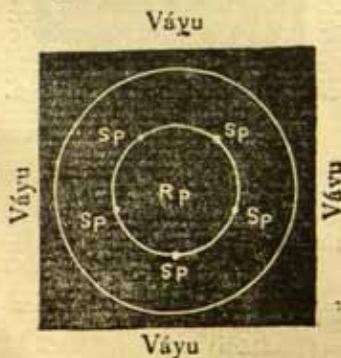
A'kása

An atom of Váyu

Sp = Sparsa-Tanmátra (impact-potential)

Sb = S'abda-Tanmátra (vibration-potential)

An atom of Tejas—heat-and-light corpuscle—has the following structure :—



An atom of Tejas

Rp = Rūpa-Tanmātra (light-potential)

Sp = Sparsa-Tanmātra (impact-potential)

and so on.

A Chemist will be disposed to push his chemical processes into the region of subtile matter. He may translate आवरण as a menstruum, and सहायक as a catalytic agent. In this case, an atom of Vāyu will be considered as generated from the impact-Tanmātra as a radicle, in the menstruum of vibration-Tanmātra, with A'kāśa-atoms as a catalytic agent.

अथायं क्रमः—भूतादिः शब्दतन्मात्रं जायते, शब्दतन्मात्रं सूतादिराहणीति, तत आकाशं जायते, ततः अस्मात् शब्दतन्मात्रात् स्पर्शतन्मात्रं जायते, स्पर्शतन्मात्रं शब्दतन्मात्रमाहणीति, एवं शब्दतन्मात्रावाहतात् आकाशसहायकात् स्पर्शतन्मात्रात् वायुर्जायते, ततः अस्मात् स्पर्शतन्मात्रात् रूपतन्मात्रं जायते रूपतन्मात्रं स्पर्शतन्मात्रमाहणीति, एवं स्पर्शतन्मात्रावाहतात् वायुसहायकात् रूपतन्मात्रात् तेजो जायते—and so on. अयं क्रमः तत्त्वव्यविवरणे कृष्णपादैरुक्तः। वरवरमुनि, तत्त्ववयभाष्य (अध्यायकरण).

A slight variation of the above view is ascribed to a certain school of Vedāntists in the तत्त्वनिर्णय.

The scheme may be represented as follows :—

A Bhūta-atom is evolved by integration (condensation and collocation, सूत्रावस्थापन) from the corresponding Tanmātra (subtile matter). This is the same view as that of the Vishnu purāṇa.

The Tanmātras again evolve from one another in a lineal series as in Parāśara's view. But the process of this generation is somewhat more complex. A Tanmātra first disintegrates and emanates in a surrounding medium (a menstruum) of the Tanmātra just preceding it in the order of genesis and with the help of its own Sthūla Bhūta as a sort of catalytic, generates the Tanmātra next in order : e.g., the infra-atomic impact particles (स्रष्टवन्मात्र) disintegrate or emanate, in a surrounding 'atmosphere' of the vibratory subtile matter (शब्दतन्मात्र) and then with the help of their own atomic integration Vāyu, gas, generate the Tanmātra next in order, the subtile matter of radiant light-and-heat (तेजः).

III. Patañjali's view, as expounded in the व्यासभाष्य and योगवासिष्ठ is as follows :—

(a) The order of genesis of various forms of subtile matter (potentials) :—

- (1) Bhūtādi, the rudiment-matter, original Mass, acted on by Rajas, Energy, produces the sound-potential (vibration-potential) अना-
नाम्नाम् अहङ्काराभ्यां सकार्यजनने राजसाहङ्कारः
सङ्कारो भवति ।

- (2) This subtile vibration-potential, as a radi-
cle, with accretion of rudiment-matter

(Bhútádi) condensing and collocating, and acted on by Rajas, generates the subtile touch-potential (impact-potential) which is impingent as well as vibratory (oscillating).

- (3) This subtile impact-potential again, as a radicle, with accretion of rudiment-matter (Bhútádi) condensing and collocating, and acted on by Rajas, generates the subtile light-and-heat potential (प्रकाशशक्ति) which radiates light-and-heat, in addition to being impingent and vibratory.
- (4) Next, the light-and-heat potential, as a radicle, with accretion of rudiment-matter, (Bhútádi) condensing and collocating as before, generates the subtile taste-potential, which is charged with the potential of the taste-energy, and of viscous attraction, in addition to being vibratory, impingent and radiant.
- (5) Lastly, the subtile taste potential as a radicle, with accretion of rudiment-matter as before, condensing and collocating, generates the subtile smell-potential, which is charged with the potential of the smell-energy, and also of cohesive attraction, in addition to being vibratory, impingent and radiant.

The order of genesis of the Bhúta Paramánuś (forms of atomic matter).

The five classes of atoms are generated as follows :—

- (1) The sound-potential, subtile matter, with accretion of rudiment-matter (Bhútádi) generates the A'kása-atom.
- (2) The touch-potentials combine with the vibratory particles (sound-potential) to generate the Váyu-atom.
- (3) The light-and-heat potentials combine with touch-potentials and sound-potentials (i.e. with impact particles and vibratory particles) to produce the Tejas-atom.
- (4) The taste-potentials combine with light-and-heat potentials, touch-potentials and sound-potentials (i.e. with radiant, impingent and vibratory particles) to generate the Ap-atom and
- (5) The smell-potentials combine with the preceding potentials (i.e. with particles of taste-energy and with radiant, impingent and vibratory particles) to generate the earth-atom.

The A'kása-atom possesses penetrability, the Váyu-atom impact or mechanical pressure, the Tejas-atom, radiant heat-and light, the Ap-atom, viscous attraction, and the Earth-atom, cohesive attraction.

Vijñāna-bhikshu in one passage gives the following scheme of the genesis of the Bhútas :—

A radicle of sound-potential with rudiment-matter gives A'kāsa-atom (Bhútādi), a radicle of touch-potential with A'kāsa-atom gives Vāyu-atom, a radicle of light-and-heat potential with Vāyu-atom gives Tejas-atom, a radicle of tastepotential with Tejas-atom gives Ap-atom, and a radicle of smell-potentials with Ap-atom gives Earth atom. On this view, an atom

of A'kāsa = Bh(Sb)

of Vāyu = { Bh(Sb) } (Sp)

of Tejas = { Bh(Sb) } (Sp) Rp

where Bh = भूतादि, Sb = स्रष्टवन्मात्र, Sp = स्रज्जन्मात्र, Rp = रूपवन्मात्र, and so on.

Bhútas and Paramānu—Cosmo-genesis and its successive stages.

The 'five Bhútas' stand for a classification of substances on the basis of their generic properties resulting, as the Sāṅkhyas hold, from the structural type of their constituent atoms—a classification more physical than chemical, or properly speaking chemico-physical, unlike the purely chemical classification of the so-called elements of modern chemistry. A Paramānu, again, is a type of atoms corresponding to each Bhúta class, and indeed one and the same kind of Paramānu may comprehend atoms

of different masses, if only these should agree in their structural type.

Cosmo-genesis—a bird's eye view :—Out of the all-pervasive rudiment-matter (Bhútādi) appeared A'kāsa (ether), first as a Tanmātra (subtile matter) charged with the potential energy of sound (vibration-potential), and then as an atomic integration of a mono-Tanmātric structure (the A'kāsa-atom—आकाशाणु) also ubiquitous and all-enveloping. In the next stage we find a new kind of Tanmātras, systems of the infra-atomic vibratory particles, so arranged as to manifest a new form of energy, that of impact or mechanical pressure and these Tanmātras (अश्रितान्दावाणि) combining with the vibration-potentials (A'kāsa Tanmātra) produced a new kind of atom, the di-Tanmātric Vāyu-atom, which by aggregation formed a gaseous envelope composed of impinging (driving) vibratory particles (Vāyu). Next appeared the third class of Tanmātras, infra-atomic systems of the impinging vibratory particles, which by their collocation developed a new form of Energy—the energy of radiant heat-and-light. These Tanmātras (अप-तन्मात्राणि) combining with the potentials (Tanmātras) of vibration and impact, produced a new kind of atom—the tri-Tanmātric Tejas-atom, the light-and-heat corpuscle, which by aggregation enveloped the gaseous world in huge flames. In the next stage we have the fourth class of

Tanmátras, new and complex infra-atomic systems of the radiant impinging vibratory particles, which evolved the energy of viscous attraction as well as the potential Energy concerned in the taste-stimulus. These Tanmátras (रसतन्मात्राणि) combining with the three previous ones, gave rise to another class of atoms, the tetra-Tanmátric Ap-atom, and the flaming gases were thus precipitated into cosmic masses of viscous fluid matters (Ap). Finally appeared the fifth class of Tanmátras infra-atomic systems of the viscous radiant impinging vibratory particles which developed new forms of Energy—the Energy of cohesive attraction, as well as the potential energy concerned in the stimulus of smell. These Tanmátras (गन्धतन्मात्राणि) uniting with the other four kinds or infra-atomic subtile particles, formed another class of atoms, the penta-Tanmátric Earth-atom. Thus the viscous fluid matters were condensed and transformed into the Earth-Bhúta, comprising the majority of the so-called elements of chemistry.

The Puránas, in their own fanciful way, conceive that, in the course of cosmic evolution, each succeeding Bhúta appeared within an outer envelope of its immediate predecessor, with a total mass (or volume ?) a tenth less than that of the latter.

विद्यत् तत्राप्येकदेशगतो वायुः प्रकल्पितः ।

चिन्तयेत् वज्रिमण्डोर्वं मरुतो न्यूनवर्त्तिनं ॥

ब्रह्माव्यावरणेष्वेवा न्यूनाधिक-विचारणा ।

वायोदंशाग्रतो न्यूनो वज्रिर्वायो प्रकल्पितः ॥

पुराणीकं तारतम्यं दशांशैर्भूतपञ्चके ॥

(पञ्चदशी-भूतविवेक, slokas 72, 81 and 82)

Examples of the different Bhútas :—

1. A'kása :—This is ubiquitous.
2. Váyu :—Various substances composed of di-Tanmátric atoms,—kinds of Váyu—must have been formed in the gaseous envelope in the second stage of cosmic evolution, out of the proto-atoms of A'kása. But they have either suffered a fresh transformation into substances of a more complex atomic structure, or have dissipated into the mono-Tanmátric A'kása, out of which they took their rise. The one familiar example now surviving is atmospheric air. Water-vapour (वाष्प) is but water (Ap), and smoke, fumes, etc. but earth-particles in gaseous diffusion.
3. Tejas .—Various classes of Tejas corpuscles,—substances with tri-Tanmátric atomic structure, i.e. two grades subtler

than the ordinary elements of chemistry (which are of a penta-Tanmátric structure),—are even now known. (तेजो भीमादि-भेदेन बहुविधं । भीमं दिव्यं शौदथे चाकरजं—वरवरमुनि,—तत्त्वत्रयभाष्य) ।

First, there is fire, or the light-and-heat emitted by the burning log of wood or lamp (अग्निः—दीपः—भीमं तेजः). Now it is important to note that the flame of a burning log of wood (इन्धन) or an oil-lamp is not pure Tejas, a pure mass of light-and-heat corpuscles. There is chemical union with Earth-particles (particles of the hard penta-Tanmátric substance) acted on by Energy ; and then the Tejas corpuscles, light-and-heat particles which are latent (absorbed) therein, come forth as flame (पार्थिवोपद्रव्येन तदनुगतात् तेजसः अग्निर्भवति—विज्ञानभिक्षु—प्रवचनभाष्य, Sūtra 110, Chap. V). Then there is the light of the sun and the stars (दिव्यं सौरं आदित्यादि) which are flaming masses of molten viscous matters (जलमादित्येन तेजः दिव्यं तच्च सूर्यादि,—तत्त्वत्रयभाष्य, अचित्प्रकरण) or of molten earthy matters सूर्यादीनि सूर्याणि तेजांसि पार्थिवद्रव्य-सङ्गेनैव अवस्थितानि,—विज्ञानभिक्षु, प्रवचनभाष्य, Sūtra . 13, Chap. III). There is also the lightning, which liberates a kind of Tejas latent in the aqueous particles and vapours, under the action of

Energy, in the same way as an ordinary fire liberates the Tejas latent in the wood or other fuel. Next there are the stores of animal heat derived from the break-up of the nutritive material (चौदर्थ्ये). Lastly there comes the peculiar form of the Tejas Energy (radiant Energy) stored up in the metalliferous ores and igneous rocks which have been formed in the subterranean heat. Here Earthy matters are mixed up, but the radiant Energy predominates in the composition of the metals (तेजसाधिकेन तेजसादिता सुवर्णादीनां—विज्ञान-निष्ठ, प्रवचनभाष्य, Sūtra 19, Chap. III). Aniruddha, a late Sāṅkhya commentator, notes in reference to 'igneous bodies' that the greater part of their mass is derived from the Earth-Bhūta, though the Tejas particles determine the peculiar chemical combination, which produces them; and this must also be his view of the composition of the metals. तत्र अपि (तेजसे शरीरे अपि) बहुतरपार्थिवव्यवायवश्चकल', अत्यन्ते आनुपमोऽस्मात् । (अनिरुद्धलि—Sūtra 112, Chap. V.)

4. Ap. This viscous fluid of a tetra-Tanmātric structure has but one pure example, viz., water, though the various organic acids, the juices of fruits and the saps of plants, are supposed to be transformations of watery radicles combined with different kinds of earthy accretions.

5. Lastly the Earth-Bhūta, the hard full-formed matter, with its penta-Tanmātric atoms, comprises by far the majority of the so-called chemical elements.

The question is,—how does one and the same Bhūta, of the same formal structure, comprise different kinds of elements, with different atomic masses, and different characteristic properties? And the answer is not far to seek. The properties of a thing are only the energies that are manifested in the particular collocations of the three Gunas,—Mass, Energy and Essence; and a tri-Tanmātric, or a penta-Tanmātric atom, *i. e.* an atom composed of three or of five kinds of Tanmātras may differ from another of the same class, in respect of the number of constituent Tanmātras of any particular kind, as also of their collocation or grouping, and therefore in mass as well as in generic and specific characters.

The Sāṅkhya-Pātañjala conceives the properties (or energies) of substances to result from the grouping or the quanta of the Tanmātras, or the Gunas themselves, and hence any radical differences in substances of the same Bhūta class must characterise their atoms, though in an infra-sensible form. In the Nyāya-Vaiśeṣika, on the other hand, the atoms of the same Bhūta class are alike in themselves, homogeneous; and the

variety of substances comprehended under the same Bhūta, is ascribed merely to the different arrangements or groupings of the atoms (ब्यूट) and not of their components, for components they have none.

As a typical and familiar instance of the variety of characteristic properties (or energies) that may result from variations in accompaniment or grouping, the Sāṅkhya-Pātañjala points to the various kinds of fruit acids and juices, all originating from one and the same Bhūta (water) with different accretions of earthy matters (स्विकाराः). In the same way, though we speak of only five classes of Tanmātras and atoms, the infinite variety of the world results from the infinitely varied collocations of the three original Guṇas, which underlie Tanmātra and atom alike (सत्त्वजसमसा अपकर्षकाठापन्नः संघातः परमाणुरिति—न्यायवार्त्तिक, उद्योतकर, reporting the Sāṅkhya view : अयुतसिद्धावयवः संघातः परमाणुरिति—व्यासभाष्य, Sūtra 44, Pada III.—परमाणुः सामान्यविशेषात्मा अयुतसिद्धावयवभेदानुगतः समुदायः—व्यासभाष्य, Sūtra 44, Pada IV,—द्योग्यतावाच्छिद्रा धर्मिणः प्रकृतिरेव धर्मः (ibid., Sūtra 14, Pada III.) यी धर्म्येषु अमुपात्तो सामान्य-विशेषात्मा सोऽन्वयी धर्म्यो (ibid., Sūtra 14, Pada III).

स्यार्द्धतत—कथं एकरूपाणां गुणानां अनेकरूपा प्रकृतिः—
इत्यत आह परिणामतः सलिलवत् । यथा वारिदविमुक्तं छदकं
एकरसं अपि तद्वद्विकारान् आसाद्य नारिकेल-ताली-विल-

चिरविल-तिन्दुकामलक-कपिलफलरसतया परिणामात् मधुरास्त्रलवण-
तिक्तकटुकषायतया विकस्यते, एवमेकैकगुणसम्भवात् प्रधानं गुणम् चाश्रित्य
अप्रधानगुणाः परिणामभेदान् प्रवर्त्तयन्ति । तदिदमुक्तं प्रतिप्रतिगुणान्वय-
विशेषात्, एकैकगुणान्वयेषु यो विशेषस्तस्मात् इत्यर्थः ।

(वाचस्पति—कौमुदी—On Káriká 16.)

If we take a unit of rudiment-matter (Bhútádi) for the unit of mass (cf. the mass of an electron with a charge of motion etc.), and represent the first Tanmátra by t_1 such units, and if further, t_2, t_3, t_4, t_5 units of mass (Bhútádi) be successively added at each accretion to form a fresh Tanmátra, then the second, third, fourth and fifth Tanmátras will respectively contain $t_1 + t_2, t_1 + t_2 + t_3, t_1 + t_2 + t_3 + t_4$, and $t_1 + t_2 + t_3 + t_4 + t_5$ units of mass.

Also the Váyu atom (bi-Tanmátric system) will contain $t_1 + (t_1 + t_2)$, i.e. $2t_1 + t_2$ units of mass; the Tejas-atom (tri-Tanmátric system) will contain $t_1 + (t_1 + t_2) + (t_1 + t_2 + t_3)$ i.e. $3t_1 + 2t_2 + t_3$ units; the Ap-atom (tetra-Tanmátric system) $t_1 + (t_1 + t_2) + (t_1 + t_2 + t_3) + (t_1 + t_2 + t_3 + t_4)$, i.e. $4t_1 + 3t_2 + 2t_3 + t_4$ units; and the Earth-atom (penta-Tanmátric system), $t_1 + (t_1 + t_2) + \dots + (t_1 + t_2 + t_3 + t_4 + t_5)$, i.e. $5t_1 + 4t_2 + 3t_3 + 2t_4 + t_5$ units.

If t units of mass be added to the first Tanmátra to form the atom of A'kása, the latter will contain $t_1 + t$ units of mass.

In other words the numbers representing the mass-units (Tamas) in the different classes of atoms (gross matter) will form an ascending series, viz. $t_1 + t$, $2t_1 + t_2$, $3t_1 + 2t_2 + t_3$, $4t_1 + 3t_2 + 2t_3 + t_4$, and $5t_1 + 4t_2 + 3t_3 + 2t_4 + t_5$.

Now if a follower of the Sāṅkhya-Pātañjala were asked to account for differences among Paramāṇus of the same Bhūta class, he would perhaps suppose t_1 to vary from α_1 to β_1 , t_2 from α_2 to β_2 , t_3 from α_3 to β_3 , t_4 from α_4 to β_4 and t_5 from α_5 to β_5 .

Therefore the mass-units contained in the Vāyu-atoms of the different possible Vāyu substances would be represented by $2\alpha_1 + t$, $2\alpha_1 + 1 + t$, $2\alpha_1 + 2 + t$, $2\beta_1 + t$, in A. P. with unity as common difference, there being $2(\beta_1 - \alpha_1) + 1$ possible Vāyu substances.

The mass-units contained in the Tejas-atoms of the different possible Tejas substances would be represented by the series, $3\alpha_1 + 2\alpha_2 + \alpha_3$, $3\alpha_1 + 2\alpha_2 + \alpha_3 + 1$, $3\beta_1 + 2\beta_2 + \beta_3$, increasing in A. P. by unity as common difference, then being $3(\beta_1 - \alpha_1) + 2(\beta_2 - \alpha_2) + (\beta_3 - \alpha_3) + 1$, Tejas substances possible.

The mass-units contained in the Ap-atoms of the different possible Ap-substances would form the series $4\alpha_1 + 3\alpha_2 + 2\alpha_3 + \alpha_4$, $4\alpha_1 + 3\alpha_2 + 2\alpha_3 + \alpha_4 + 1$, $4\beta_1 + 3\beta_2 + 2\beta_3 + \beta_4$, there being $4(\beta_1 - \alpha_1) + 3(\beta_2 - \alpha_2) + 2(\beta_3 - \alpha_3) + (\beta_4 - \alpha_4) + 1$ Ap-substances possible.

The mass units contained in the Earth-atoms of the different possible Earth-substances would form the series in A. P., $5\alpha_1 + 4\alpha_2 + 3\alpha_3 + 2\alpha_4 + \alpha_5$, $5\alpha_1 + 4\alpha_2 + 3\alpha_3 + 2\alpha_4 + \alpha_5 + 1, \dots, 5\beta_1 + 4\beta_2 + 3\beta_3 + 2\beta_4 + \beta_5$, there being $5(\beta_1 - \alpha_1) + 4(\beta_2 - \alpha_2) + 3(\beta_3 - \alpha_3) + 2(\beta_4 - \alpha_4) + (\beta_5 - \alpha_5) + 1$ Earth-substances possible.

Size (परिमाण).—As to size or volume, the Sāṅkhya accepts only two kinds,—the infinitesimal, which is also without parts (अणु—निरवयव) and the non-infinitesimal, which consists of parts (सङ्घत्—सावयव). The latter varies from the excessively small (the so-called *Amus*, *Tanmātras* and *Paramānus*) to the indefinitely great (परमसङ्घत्—विष्णु,—e.g.—*A'kāśa*).

The *Gunas* alone are infinitesimal, with the exception of those ubiquitous ones that evolve into *A'kāśa*-atoms and Mind-stuff (आकाशाणु and चक्षुःकरण):—all the rest of the evolved products (whether subtle or gross matter) are non-infinitesimal.

Vijñānabhikṣu notes that all the *Gunas* (Reals) cannot be ubiquitous. If this were the case, that disturbance of equilibrium, that unequal aggregation with unequal stress and strain, with which cosmic evolution begins, would be impossible. The *Gunas*, which give rise to *A'kāśa* and Mind-stuff, must be held to be ubiquitous, and this will suffice for the ubiquity of *Prakṛiti*,

(न च अस्मद्दर्शने गुणाख्यप्रकृतेः विभुत्वमेवावगम्यते इति वाच्यम् ।
 अन्तःकरणाकाशहेतुगुणानां विभुत्वेन तदुपपत्तेः । सर्वगुणानां विभुत्वे
 सति आद्यपरिणामहेतुत्वोभसंयोगाद्यसंभवात् (योगवार्त्तिक, Sūtra 51,
 Pada III.)

Chemical analysis and Synthesis—Elements and Compounds.

What then is the equivalent in the Sāṅkhya-Pātañjala of the distinction between a chemical element and a chemical compound, or is there none? Did or did not this elaborate physical analysis and classification of things lead on to a classification based on chemical analysis and chemical synthesis? These are questions of singular interest, the answer to which will disclose some new points of view from which the ancient Hindu thinkers approached the problems of chemical physics and physical chemistry.

Aggregates (समूहाः) may, in regard to their structure, be divided into two classes, (1) those of which the parts are in intimate union and fusion, being lost in the whole (अद्युतसिद्धान्तवाः समूहाः); and (2) mechanical aggregates, or collocations of distinct and independent parts (व्युत्सिद्धान्तवाः समूहाः).

A substance is an aggregate of the former kind, and may be divided into two classes, (1) the Bhūtas and their 'isomeric' modifications भूत, भूतभेद and भूतविकार); and (2) chemical compounds (मिश्रितद्रव्य,

सद्वत्सूतार्थं). Chemical compounds again may be subdivided into two classes, (1) those composed of atoms of the same Bhūta class, i.e. of different isomeric modifications of the same Bhūta, and (2) those composed of atoms of different Bhūta classes. In the first case, there is contact between 'isomeric' atoms (सजातीय-संयोग), in the second case, between heterogeneous or 'polymeric' ? atoms (विजातीय-संयोग). The first contact leads to intimate union (सद्वः—सद्वत्सूतः यः संयोगविशेषः तेनैव द्रव्याणां विकारी भवति—विज्ञानमिश्र प्रवचनभाष्य): the isomeric atoms by a peculiar liberation of Energy (सजातीयोपदन्त—the action of similars on similars) are attracted towards one another, and being riveted as it were, form the so-called material cause (उपादान कारण) of the compound product. The second kind of contact (that between unlike or 'polymeric' ? atoms of heterogeneous Bhūtas) begins with a liberation of Energy (उपदन्त), which breaks up each of the Bhūtas, and taking particles (or atoms) of one as nuclei or radicles groups particles of the rest round these radicles in a comparatively free or unattached condition. In this case, one Bhūta, that which serves to furnish the radicles, not necessarily that which is numerically or quantitatively predominant, gets the name of material cause (उपादानकारण), and the others, which by their collocation cause the liberation of Energy (उपदन्त, अवदन्त or विदन्त).

are called efficient causes (निमित्त कारण)—एवमेकैक-
 गुणसम्भवात् प्रधान गुणमाश्रित्य अप्रधानगुणाः परिणामभेदान्
 प्रवर्तयन्ति—वाचस्पति, कौमुदी on Kárika 16. The illus-
 tration given (viz. the Rasas as modifications of
 Ap, water, with Earth-accretions) show that this
 process applies not only to the Gunas, but also to
 the Bhútas. यथा आकाशादिकरसं सल्लिखं पतितं नानावपात्
 संश्लेषात् भिद्यते—(गौडपाद on Káriká 17).—तत्र अपि (तेजस-
 शरीरे अपि) बहुतरपार्श्ववावयवावटम्भात् अल्पत्वे च अनुपभोगात् (अनिरुद्ध
 on Sūtra 112, Chap. V), जातिसादृश्यं च अद्याकमदीयत्वात्
 सामयौसनवधाने अनेकैरपि इन्द्रियैः एकदा एकवस्तुत्पादने बाधकं नास्ति
 (विज्ञानमिश्र—प्रवचनभाष्य).

Aniruddha goes so far as to hold that both
 'isomeric' and 'polymeric' (or 'heterogenic') com-
 binations are real cases of constitutive contact,
 (आरम्भकसंयोग, *e.g.* भौतिकवायोर्देहारम्भकत्वम्—अनिरुद्ध on Sūtra
 113, Chap. V.) But in the later Sāṅkhya-Pātañjala
 the current teaching denied this—बह्वनामुपादानाद्योगात्
 (Sūtra 102, Chap V), when विज्ञानमिश्र notes—बह्वनां
 भिन्नजातीयानां योपादानत्वं न दृष्टमिति सजातीयमेवोपादानम्। इतरञ्च
 मूलवस्तुत्पद्यमुपपन्नकम्।

But besides these transformations of substance
 (द्रव्यान्तर-परिणाम) by 'isomeric' or 'heterogenic'
 process, ceaseless changes go on in the characters,
 the modality, and the states of substances—changes

which are due to the unequal distribution of force (or of stress and strain,—pressure) among the Gunas, which are in themselves constant. (धन्वं. लक्षणावस्थापरिणामाः न द्रव्यान्तरतः,—यथा एका रेखा शतस्थाने शतं दशस्थाने दश, एकचैकस्थाने, यथा चैकलेऽपि सौ माता चोचते दुहिता च स्वसा चति,—गुणिनित्यत्वेऽपि गुणानां विमर्दवैचित्र्यात्—व्यासभाष्य, Sūtra 13, Pada III.)

“Even as the same figure ‘1’ stands for a hundred in the place of hundred, for ten in the place of ten, and for a unit in the place of unit.”*

* This conclusively proves that the decimal notation was familiar to the Hindus when the Vyāsa-Bhāṣya was written, i.e. centuries before the first appearance of the notation in the writings of the Arabs or the Greco-Syrian intermediaries. Vāchaspati, who comments on the Vyāsa-Bhāṣya, composed his Nyāya-Sūchi-Nibandha in बसवसुवर्गरे i.e. Samvat 898 or 842 A. D. This cannot be S’aka 898, for apart from the decisive use of वत्सर, which by this time had come to signify the Samvat era, Vāchaspati’s commentator Udayana, wrote the Lakṣaṇāvalī in S’aka 906—

तर्काभिराहमितिष्वतीतेषु शकात्ततः ।

वर्षेद्वयशके सुबोधो लक्षणावलीम् ॥

and Udayana, who wrote the Parisuddhi on the Tātparyya-tīkā of Vāchaspati, could not have been a contemporary of the latter, as will also appear from the invocation to Sarasvatī in the opening lines of the Parisuddhi. Vāchaspati then preceded Udayana by 142 years, and must have been himself preceded by the author of the Vyāsa-Bhāṣya by a

Now the question is—in these mixed substances does the fusion take place by Paramānu or by larger masses (or lumps)? Now a Paramānu is defined to be the smallest portion of any substance which exhibits the characteristic qualities of that substance,—in other words, it stands for the smallest homogeneous portion of any substance. It is not without parts and therefore not indivisible. It is subject to disintegration. In a Bhūta or its isomeric modification, the Paramānu, the smallest homogeneous component particle, is unmixed, and therefore corresponds to the atom of modern chemistry. In a mixed substance (मिश्रद्रव्य, संघटभूताद्ये) whether it is an 'isomeric' or a 'polymeric' compound, the qualities are due to the mixture, and therefore its Paramānu, the smallest homogeneous particle possessing its characteristic qualities, must result from the mixture of the Paramānus (in smaller or larger numbers as the case may be) of the component substances. The Para-

longer interval still, for Vāchaspati ascribes the Bhāṣhya to Veda-Vyāsa himself (वेदव्यासेन भाषिते भाष्ये व्याख्या विधासते). The internal evidence also points to the conclusion that the Bhāṣhya cannot have been composed later than the sixth century,—cf. the quotations from Pañchasikha, Vārshaganya, and the Shashī-Tantra-S'āstra, without a single reference to I'svara-Krishna—which is decisive. I may add that I remember to have come across passages of a similar import in Buddhist and other writings of a still earlier date.

mānu of a mixed substance therefore corresponds to what we now call molecule. (अपकर्षपर्यन्तं द्रव्यं परमाणुरिति—व्यासभाष्य । लोहस्य हि प्रविभज्यमानस्य यस्मिन्नवयवे अल्पतमं तारतम्यं व्यवतिष्ठते सः अपकर्षपर्यन्तपरमाणुः—वाचस्पति—तत्त्ववैशारदी—Sūtra 52, Pada III.—नाणुनित्यता न निर्भागत्व' । पृथिवीपरमाणुः जलपरमाणुरित्यादिव्यवहारस्तु पृथिव्यादीनामपकर्षकाङ्क्षाभिप्रायेणैव । विज्ञान-मिच्छा—प्रवचनभाष्य, Sūtra 88, Chap. V.)—That the Paramānus form molecules (वाणुक) in forming substances, is acknowledged by the Sāṅkhyas as will appear from Gaudapāda,—तथा अन्योन्याश्रयाच्च वाणुकवदनुशाः । (गौडपाद, on Kārikā 12). Even the Vaiseshikas, with their prejudice against 'polymeric' or 'heterogenic' combination, acknowledge that in 'polymeric' compounds the different Bhūta-substances unite by their Paramānus (or atoms), though they rigidly insist that in such cases only one atom should be regarded as the 'radicle' (उपादान or द्रव्यारम्भककारण) and the others as co-efficient causes (निमित्तकारण—उपटन्त्रक), e. g. प्रशस्तपाद—एवं समुत्पन्नेषु चतुर्षु महाभूतेषु महेश्वरस्याभिधानमात्रात् तैजसेभ्योऽणुभ्यः पार्थिवपरमाणुसहितेभ्यो महदणुमुत्पद्यते (प्रशस्तपादभाष्य—where S'rīdhara notes पार्थिवं अवयवा उपटन्त्रकाः and Udayana तैजसानां परमाणूनां पार्थिवाणुसहितेन अणुसहितरूपेणैव विवक्षितं) ।

It is only in the mediæval Sāṅkhya-Pātañjala that under the influence of the Nyāya-Vaiśeṣika doctrine a radical difference was conceived to exist between the structure (or constitution) of a molecule composed of 'isomeric' atoms, and that of one composed of heterogeneous (or 'polymeric') atoms. In the former case, there was believed to take place intimate union (सङ्ग), in the latter case, only a grouping of comparatively free or loosely attached atoms round a radicle atom (मूलम), with liberation of Energy (उपपन्न—उद्भूत—or विपन्न) and the setting up of unequal stress and strain (गुणवैषम्यविमर्श—द्वन्द्वरूपता). At the same time, it was of course admitted that this distinction does not apply to the forms of subtile matter (Tanmātra—सूक्ष्मसूत) which could unite in intimate fusion, whether homogeneous or heterogeneous. For example, the subtile body (सूक्ष्मशरीर) which is supposed to be the seat or vehicle of the conscious principle is acknowledged by Vijñāna-bhikṣhu to be penta-Bhautic (पञ्चभूतात्मक); in other words, all the five Tanmātras serve as material causes, though the gross body (the animal organism) is stated to be only a 'polymeric' compound with the Earth-Bhūta as radicle or base. अधिष्ठानशरीरं च सूक्ष्मं पञ्चभूतात्मकं वक्ष्यते । तन्मात्रकाव्ये यत् सूतपञ्चकं लिङ्गाधिष्ठानं शरीरम् (प्रवचनभाष्य—Sūtras

11 and 12, Chap. III.—अज्ञानस्यैव पार्थिवमेव चान्यानि च
सूतानि उपपद्यन्तानि (*ibid.* Sūtra 19, Chap. III.)

But in the original Sāṅkhya-Pātañjala it appears that the production of a new substance by mixture of unlike Bhūtas (विजातीयसंयोग) was conceded as freely as in the Vedānta, and was conceived as nowise differing from the formation of a compound of atoms of the same Bhūta class. The Sāṅkhya analysis of all change into transformations of Energy due to collocations of unchanging Gunas, in other words, the prevailing chemico-physical (or physical) point of view, naturally recognises no distinction between collocations of 'isomeric' and those of heterogeneous (or 'polymeric'?) atoms. At bottom they are all collocations of the Gunas. Even Vijñāna-bhikṣhu who, as one of the latest expounders of the Sāṅkhya-Pātañjala, has been most affected by the Vaisesika prejudice against 'polymeric' combination (विजातीयसंयोग) urges that the qualities of a compound substance are not necessarily the result of similar qualities in the component elements. (सजातीय-कारणगुणस्यैव कार्यगुणारम्भकता इति तु तेषां (सार्जिकाणां) अपि न नियमः ।) Elsewhere he explains that far from the vital activity being independent it is originated and maintained by the combined operation or fusion of the different sensory and motor reflexes of the living

organism, and notes that the united operation of mixed (or miscellaneous) causes, where there is a fit collocation of matter, offers no difficulty to a follower of the Sāṅkhya-Pātañjala :—(जातिसादृश्यं यथाकमदो-
यत्वात्, सामग्रीसमवधाने सति अनेकैरपि इन्द्रियैः एकदा एकवस्तुत्-
पादने बाधकं नास्ति—प्रवचनभाष्य, Sūtra 32, Chap. II). In the middle of the ninth century, we find Vāchaspati instancing some 'heterogenic' or 'polymeric' compositions as typical examples of evolutionary change (परिणाम) and unhesitatingly accepting the substantive character of the products. In the Kaumudī he describes the various acids and juices of fruits as modifications of the same original water in the presence of different kinds of earthy accretions. The process is peculiar. The water-particle (or atom) serves as a radicle or centre of a system, and the different kinds of the Earth-Bhūta centering round this as a nucleus become the seat of forces, which bring in the development of new energies (and new qualities, *e.g.* tastes) in the water. यथा वारिद्विमुक्तमुदकं
एकरसमपि तत्तदभूतविकारान् आसाद्य नारिकेल-ताली-बिल्व-कपित्थादि-
रसतया परिणामात् मधुरास्त्रलवणतिक्तकटुकषायतया विकल्पते । इति
एकैकगुणसम्भवात् प्रधानगुणम् आद्रित्य अप्रधानगुणाः परिणामभेदान्
प्रवर्तयन्ति । (कौमुदी on Kārikā 16). Vāchaspati also points out that different substances may be transformed into one and the same substance (*e.g.*

the production of salt by the cow, the horse, the buffalo and the elephant, thrown into the salt factory of Sambara in Rajputana or of the flame of a candle by the combination of wick, oil and fire. (परिणामेकत्वं बहूनामपि एकः परिणामः दृष्टः । तद्वयसा मवाऽत्र-महिषमातङ्गानां समानिच्छिन्नानां एकलवणत्वजातीयलक्षणाः परिणामः, वर्तितैलान्नानां च प्रदीप इति ।—तत्त्ववैज्ञानरत्नो on व्यासभाष्य, Pada IV. Sūtra 14.)

Earlier still, *i.e.*, not later than the sixth century, the Vyāsa-Bhāṣya, noting that inorganic matter, vegetable substances and animal substances do not differ from one another essentially in respect of their potential energies and ultimate constituents, points out that various bi-Bhautic chemical compounds of water and earth substances, in the shape of saps, acids and juices, are found in plants in their different parts (जलभूम्योः पारिणामिकं रसादिवैद्यक्यं स्यादत्रैव दृष्टम्). In other words, bi-Bhautic compounds are here placed in the same category as 'isomeric' compounds of substances of the same Bhūta class, for here the particles of both the Bhūtas are regarded as forming the matter (material cause—उपादानकारण) of the smallest homogeneous portions of the compound substances.

N.B.—Vāchaspati naturally interprets this to mean separate modifications of the two Bhūtas.

The view of the earlier Sāṅkhyas that atoms of different Bhūtas may chemically combine to form molecules of compound substances as much as atoms of different modes of the same Bhūta comes out clearly in Utpala's brief reference to the Sāṅkhya system in his commentary on Varahamihira's *Vrihat Samhita*. (पञ्चः पञ्चभ्यः [तन्मात्रेभ्यः] पञ्चमहाभूतानि भवन्ति । तेभ्यः शरीरिणां शरीराणि । यतः पञ्चमहाभूतमयाणि शरीराणि Utpala, Chap. I, S'loka 7).

Chemistry in the medical schools of ancient India :—As a matter of fact, long before the fifth century, probably as early as the first century A. D., the prevailing schools of medicine and surgery which were based on the S'āṅkhya teaching with a methodology derived from the Nyāya-Vaisesika doctrine (cf. Charaka, S'ārīrasthāna, Chap. I, Vimānasthāna, Chap. VIII—also Susruta, S'ārīrasthāna, Chap. I) had founded an elaborate theory of inorganic and organic compounds, which equally admitted iso-Bhautic and hetero-Bhautic combinations. Like the Vedantists, Charaka held that each of the gross Bhūtas (Mahābhūtas) is a peculiar ultra-chemical compound of five original subtile Bhūtas. In this sense, every substance is penta Bhautic, but for purposes of chemical analysis and synthesis, i. e. considered with reference to the Mahābhūtas, all substances in their chemical constitution, belong to

one or other of the following classes : Mono-Bhautic, bi-Bhautic, tri-Bhautic, tetra-Bhautic, and penta-Bhautic. Compounds of different Bhûtas, again, may combine to form more complex substances, and these in their turn, higher compounds still, and so on in progressive transformation, as is more specially the case with organic substances and products.

Physical characters of the Bhûtas :— The prevailing physical characters of the different Bhûtas and their isomeric modes are enumerated as follows.

Earth-substances—Heavy, rough, hard, inert, dense, opaque, exciting the sense of smell.

Ap-substances—Liquid, viscous, cold, soft, slippery, fluid, exciting the sense of taste.

Tejas-substances—Hot, penetrative, subtle, light, dry, clear, rarefied, and luminous.

Vāyu-substances—Light, cold, dry, transparent, rare-fied, impingent.

Akāsa-substances—Imponderable (or light), rarefied, elastic, capable of sound (vibrations).

(गुरुस्वरकठिनमन्दस्मिराविषदसान्द्र-स्थूलगन्धगुणबहुलानि पार्थिवानि ।
द्रवस्निग्धशीतमन्दसदुपिच्छिलसरसगुणबहुलानि आप्यानि । उष्णतीक्ष्णसूक्ष्म-
सद्गुरुस्वविषदरूपगुणबहुलानि वाय्वेयानि । लघुशीतरुक्स्वरविषदसूक्ष्मस्पर्श-

गुणबहुलानि वायव्यानि । सुदुलघुमुष्णद्रव्यामन्दगुणबहुलानि आकाशात्म-
कानि ।—Charaka, S'ārīrasthāna, Chap. 26 ; compare
Susruta, Sūtrasthāna, Chap. 41).

Charaka points out that the primary qualities or specific physical characters of the five Bhūtas are tactile qualities, i. e. sensible to touch, e. g. hardness (or roughness) for Farth, liquidity (or yielding to pressure) for Ap, impelling or moving force (pressure) for Vāyu, heat for Tejas, and Vacuum (non-resistance, penetrability) for A'kasa.

(खरद्रवचलोचलं भूजलानिलतेजसाम्,

आकाशस्याप्रतीघातो दृष्टं लिङ्गं यथाक्रमम् ।

लघवं सर्वमेवेतत् स्रष्टुर्निन्द्रियगोचरम् ।

Charaka-S'ārīrasthāna, Chap. I.)

(cf. the elaborate enumeration of physical characters quoted in Vijñāna-bhikshu, Yoga-Vārtika, Sutra 42, Pada I ;—also Varavara's commentary on Tattva-traya Achit-prakarana).

The Mahā-Bhūtas—mechanical mixtures :—
Susruta notes that each of the gross Bhūtas (Mahā-bhūtas) is found mixed up with the other Bhūtas ;—e. g., the Mahābhūta A'kasa is the receptacle (or vehicle) of air, heat-and-light, and water vapour ; the Mahābhūta Vāyu, of water-vapour, light-and-heat, and even fine particles of Earth held in suspension ; the Mahābhūta Tejās, of earth-particles in the shape of smoke, and also water-vapour.

(अम्लोऽन्यानुप्रविष्टानि सर्वान्वेतानि निर्दिशेत्—Susruta, Sārīra-
sthāna, Chap. I.) अम्ले पुनः अम्लया व्याचक्षते । आकाशे पवन-
दहन-तीक्ष्णानि । वायौ तेजोऽम्बुनौ । भूरपि अणुताविशेधेव । भूमिरपि
धूमादिरूपेण तेजसि । तेजोद्रव्ये पानीयमपि ।—Dalvana on
Susruta, loc. cit.)

Mono-Bhautic Earth-substances :—Charaka and
Susruta regard the following as Earth-substances—
Gold, the five Lobas (silver, copper, lead, iron and
tin) and their 'rust', arsenic, orpiment, various
mineral earths and salts. sand, precious stones,
(Charaka, Sūtrasthāna, Chap. I. Cf. also Susruta,
Sūtrasthāna, Chap. I—पाचिंशः सुवर्णं रजतमणिमुक्तामनः-
प्रितान्मृत्कपालादयः । सुवर्णस्य दह पाचिंशत्वमेवाकूलीक्रियते गुरुत्वकाठिन्य-
स्यैर्ध्यादिर्दुर्गुणिः । मृदे आदिपृथगात् लोहमलसिकतामुषाहरिताललवण-
गैरिकारसाङ्गान् प्रभृतीनां—Dalvana on Susruta, loc. cit.)

The salts include common salt, saltpetre, etc.
Susruta mentions, the alkalis, borax, natron,
Yavakshāra (carbonate of potash) etc. The Audbhida
salt, an inflorescence of the soil, stands for *reh* (चीरिदं
पांशुलवर्णं यज्जातं भूमितः खयम्).

Of these Earth-substances, some were known
to be compounds, *e. g.* the chemical salts of the
metals, collyrium etc. Susruta describes the pre-
paration of the metallic salts. The leaves of the
metals were pasted over with the salts, and then
roasted (अयस्कृति) (Chikitsāsthāna, Chap. 10).
These metallic salts are therefore mono-Bhautic
Earth-compounds. Susruta also gives the preparation
of mild and caustic alkalis. (Sūtrasthāna, Chap. 11.

Origin of precious stones :—Some hazarded the guess that the precious stones are rocks (or earths) metamorphosed by natural process in the course of ages (Varāhamihira—वेचितां प्राक्कल्पानाम् केचित् सुवः स्वभावात्—Utpala notes, —रत्नरूपत्वं प्राप्ताः कालाकरिणः).

Ap-substances, simple and compound :—

Susruta, following Charaka, enumerates various classes of Ap substances (द्रवद्रव्य) as follows :—waters, acids, milks, curds, butters, oils (vegetable as well as animal), fats, honeys, molasses, alcoholic liquors, urines etc.

Pure Ap (Mahābhūta) is tasteless and the six tastes are developed when the Mahābhūta Ap enters into combination, mechanical or chemical, with other Mahābhūtas. Susruta notes that various kinds of Earths are dissolved in the waters of different localities, and where the particles so dissolved are predominantly Earthy, the water tastes acid or salt,—where predominantly watery, the resulting taste is sweet,—where the Earth particles are mixed up with Tejas, the water tastes pungent or bitter etc. Such is the case with mechanical mixtures. In the case of bi-Bhautic or tri-Bhautic compounds Charaka mentions that substances with Mahābhūta Ap predominating in their composition taste sweet; with Mahābhūtas Earth and Tejas predominating, acid; with Mahābhūtas Ap and Tejas predominating, salt; with Mahābhūtas Vāyu and Tejas predominating, pun-

gent ; with Mahābhūtas Vāyu and Ākāśa predominating, bitter ; and with Mahābhūtas Vāyu and Earth predominating, astringent (Charaka, Sūtrasthāna, Chap. 26,—cf. Susruta, Sūtrasthāna, Chap. 42).

In fact with the exception of Susruta's waters which are mechanical mixtures, or rather solutions, all these Ap-substances are organic products and, as such, penta-Bhautic, *i. e.* compounded of all the five Mahābhūtas, and the particular 'taste' which is developed depends on the relative proportion of the Mahābhūtas, and the predominance of one or more of them in the penta-Bhautic compound in question.

Qualities of Compounds.—The isomeric modes of each Mahābhūta have specific colours, tastes etc. due to their structure, *i. e.* the arrangement of their atoms, and the physico-chemical characters of compounds whether of the same or of different Mahābhūtas result from the collocation in unequal proportion of the different forces latent in the atoms of the component substances. Charaka adds that the varied forms (textures) and colours of organic substances, whether vegetable or animal, are derived in the same way. एवमेतेषां रसानां षट्समुपपन्नं न्यूनातिरेकविशेषात् महामृतानाम् । मृतानामिव स्याद्वरजद्रव्यानां नानावर्णाकृतिविशेषाः ।

Susruta ignores Charaka's distinction between Mahābhūta and subtile Bhūta, and views every

substance as in reality penta-Bhautic and it is only the relative predominance of a particular Bhúta or Bhútas in any substance that determines its class. (एष्विष्यमेकीवायुकाशानी समुदायात् द्रव्याभिनिर्हतिः । उत्कर्षस्तु अभिव्यञ्जकी भवति इदं पार्थिवं इदं वायुं इदं तेजसं इदं वायव्यं इदं आकाशीयमिति । Susruta, Sūtras-thāna Chap. 41)

The extant Charaka and Susruta—Succession of medical authorities :—

The extant Charaka and Susruta, the sources of our present information regarding the progress of scientific knowledge in the medical schools of Ancient India, are both redactions of original authorities. The extant Charaka is a redaction by Dridhabala of the genuine Charaka Samhitā which was itself a redaction by Charaka of the original work of Agnivesa, the disciple of A'treya Punarvasu as distinguished from Krishnātreya and Bhikshu A'treya, also well-known medical authorities. The extant Susruta is a redaction by Nāgārjuna of an original work (Vridhdha Susruta) by Susruta, the disciple of Dhanvantari. That Charaka preceded Susruta is almost certain. Nāgārjuna was probably earlier than Dridhabala. At any rate, Dridhabala imported into Charaka much of the surgical knowledge which had till then been the traditional heritage of the Susruta school. And in the matter of the surgical treatment of certain diseases, the genuine Dridhabala is often as

advanced as Susruta's redactor himself. The latter was probably identical with the alchemist Nāgārjuna (Siddha Nāgārjuna), the metallurgist Nāgārjuna (author of a treatise on metallurgy, *Lohas'āstra*), and the Buddhist Nāgārjuna, author of the *Mādhyamika-sūtravṛtti*. Charaka and Susruta continued to receive additions after Dridhabala and Nāgārjuna, and even after Vāgbhata, but the whole of the extant Charaka is probably much earlier than the commentator Chakrapāni, and the whole of the extant Susruta earlier than Dalvana, the commentator, and Mādhava, the author of *Rugvinischaya*. The extracts in Vāgbhata make it certain that the passages I have quoted or shall quote from the *Sūtrasthāna* and *S'ārīrasthāna* of Charaka and Susruta cannot be later than the sixth century of the Christian era.

Preparation of Chemical Compounds.—The knowledge of chemical compounds and of their preparation continued to make progress in the Charaka and Susruta Schools. The great metallurgist, Patañjali, in his treatise on Metallurgy (लोहशास्त्र) gave elaborate directions for many metallurgic and chemical processes specially the preparation of the metallic salts, alloys and amalgams, and the extraction, purification and assaying of metals. Probably it was Patañjali who discovered the use of the mixtures called *Vidas*.

which contained aqua regia or other mineral acids in potentia. Unfortunately Patañjali's *magnum opus* appears to have been lost, but extracts from it are frequently found in mediaeval works on Medicine and Rasáyana, which leave no doubt as to its remarkable scientific value. The metallurgist Nágárjuna advanced the knowledge of chemical compounds by his preparations of mercury. The Harshacharita, in the seventh century, relates a fable concerning this Nágárjuna, and speaks of him as a friend and contemporary of Sátaváhana. The relative priority of Patañjali and Nágárjuna is a vexed question in the history of metallurgy. That Nágárjuna's Lobasástra was earlier than the final redaction of Patañjali will appear from the following circumstances :—(1) Chakradatta in his summary of Nágárjuna mentions that the chemical process of testing pure iron must be repeated twice before it can be regarded as decisive, whereas S'ivadása Sen's extract from Patañjali shows that the latter directed the process to be repeated seven times ; (2) Patañjali in the Abhraka-vidhi (mica operation) adds mercury, which in this particular operation is wanting in Nágárjuna's recipe (cf. Chakradatta, and Patañjali as reported in the Yogoratránákara-samuchchaya) ; and (3) Nágárjuna is quoted in the earlier compilations, Patañjali in the later.

Early in the sixth century, Varáhamihira in the

Vrihat Samhitā gives several preparations of cements or powders called Vajra-lepa "cements strong as the thunderbolt;" and there was ample use for these in the temple architecture of the Buddhist period, the remains of which bear testimony to the adamant strength of these metal or rock cements. (प्रासादद्वयवर्णनमीतिहास-प्रतिमासु कुचकूपेषु सन्तो दातव्यो वषट्कसायुतस्याद्यौ । Chapter 56, *Ibid.*). Varāhamihira also alludes to the experts in machinery (यन्त्रविदः, यन्त्रज्ञाः) and the professional experts in the composition of dyes and cosmetics (रामयन्त्रयुक्तिविदः Ch. 16, also Ch. 15). I would also refer to the interesting Chapter on Perfumery (Ch. 76) where Varāhamihira gives various recipes for artificial imitations of natural flower scents as of the essence of Vakula, Utpala, Champaka, Atimuktaka &c., arranges compound scents in a sort of scale according to the proportions of certain ground essences used in their preparation, and determines by the mathematical calculus of combination (लोटकप्रसार) the number of variations of the different notes in this scale. To these classes of professional experts were due three of the great Indian discoveries in the chemical arts and manufactures which enabled India to command for more than a thousand years the markets of the East as well as the West and secured to her an easy and universally recognised pre-eminence among the nations of the world in

manufactures and exports :—(1) the preparation of fast dyes for textile fabrics by the treatment of natural dyes like *Mañjisbthā* with alum (तुवरी मञ्जिहा रागवन्निनी) and other chemical (*e. g.* sulphate of iron) also cow-dung (cf. the “cowdung substitute”, Roscoe); (2) the extraction of the principle of indigotin from the indigo plant by a process which however crude is essentially an anticipation of modern chemical methods; and (3) the tempering of steel in a manner worthy of advanced metallurgy, a process to which the mediæval world owed its Damascus swords. It was this applied chemistry much more than handicraft skill which gave India her premier position in the middle ages and earlier (indeed from Pliny to Tavernier) in exports and manufactures; for in handicraft skill as in design and workmanship, great as were her merits, India came to be surpassed by her disciples China and Japan.

The *Vāsavadattā* and the *Dazakumāra Charita* in the sixth century allude to the preparation of a mass of fixed or coagulated mercury (पारद-दिग्ग इव कालघातुवादिनः—वासवदत्ता); a chemical powder, the inhalation of which would bring on deep sleep or stupor (योगचूर्ण—दशकुमारचरित); a chemically prepared stick or wick for producing light without fire (योगवर्तिका—दशकुमारचरित); and a powder which like anæsthetic drugs or curare, paralyses

sensory and motor organs (सन्धनचूर्णनिव इन्द्रियाणाम्—वासवदत्ता—धीन्द्रियकर्मेन्द्रियाणामिति दर्शयः). Vrinda (circa 950 A. D.) notices the preparation of sulphide of mercury (रसास्रतचूर्णं) composed of one part of sulphur, and half its weight of mercury; and also of cuprous sulphide (पर्यटिताम्). Chakrapāni (circa 1050 A. D.) mentions the preparation of the black sulphide of mercury, "by taking equal parts of mercury and sulphur".

The Rasārṇava (circa 1200 A. D.) notices the colours of metallic flames, probably after Patañjali; e. g. copper gives blue flame; tin, pigeon-coloured; lead, pale; iron, tawny; blue vitriol, red. It may be noted that the Rasārṇava regards mercury as a penta-Bhautic substance.

The Rasaratna-samuchchaya divides the mineral kingdom (Earth-substances, simple and compound) into the following classes:— (1) The eight Rasas, mica, pyrites, bitumen, blue vitriol, calamine, etc. (2) The eight Uparasas (useful in operations of mercury), sulphur, red ochre, green vitriol, alum, orpiment, realgar, collyrium, and medicinal earth, to which may be added the eight Sādhārana Rasas, sal-ammoniac, cowrie, cinnabar, rock vermilion, etc. (3) The gems, diamond, emerald, sapphire, cat's eye, sun-stone, moon-stone, pearl, etc. (4) The metals,

gold, silver, iron, copper, lead, tin, and the alloys—brass and bell-metal. Other Earth-substances are six salts, three alkalis, mineral earths, and several poisons (cf. vol. I, pp. 32-98).

Chemical compositions and decompositions—metallurgic processes.—In these writings, we frequently come across instances of chemical composition and decomposition, by processes, more or less crude, of calcination, distillation, sublimation, steaming, fixation, etc. (भस्मीकरण, पचःपातन, ऊर्ध्वपातन, स्नेहन, सन्धन etc.) e.g. the preparation of perchloride of mercury by taking common salt and mercury (रसकर्पूर—पारदस्य जेत-भस्मीकरणे चन्द्रिकाकारः); of sulphide of mercury (हिङ्गुल) by taking sulphur and mercury; of Sindūra from lead (सिन्दूरं नागसन्धवम्—Amara-kosha sixth century A. D.);—of the medicinal compounds, Svārṇa-sindūra and Rasasindūra, with mercury, sulphur and gold, where gold may have been fancied to influence the resulting compound in some mysterious way, either as a 'dynamic' or as a catalytic;—also the extraction by chemical decomposition of mercury from sulphide of mercury (हिङ्गुल,—vide रसरत्नसमुच्चय); of copper from sulphate of copper (तुल्य, सस्रक्) by heating this substance with one-fourth of its weight of borax (Rasaratna-samuchchya,—cf. Bhāvaprakāsa, तुल्यं

तु ताम्रपथात् किञ्चित् ताम्रेष तद्वति); of zinc (वदाम, असद) from calamine (रसक—Rasārṇava); of copper from pyrites (माक्षिक, विसख, etc.—Rasārṇava, (though the golden pyrites were supposed to be a semi-metal of gold, containing some gold along with the essence of copper)—the purifications of mercury by repeated distillation from lead and tin with which it was wont to be adulterated in the market. The various metallurgic processes described are—extraction, purification, killing (formation of oxides, chlorides and oxy-chlorides for the most part), calcination, incineration, powdering, solution, distillation, precipitation, rinsing (or washing), drying, steaming, melting casting, filing, etc. to all which each of the known minerals was successfully subjected by the use of apparatus and reagents and the application of heat in different measures (खरपाक—मध्यमपाक—and मृदुपाक),—methods which, if often crude, especially from the absence of independent and isolated mineral acids, were yet in several instances remarkably simple and effective, and which, after all by the use of various Vidas potentially containing mineral acids aqua regia, sulphuric acid, hydrochloric acid, etc.) virtually accomplished the practical ends kept in view. To these were added several special processes for mercury (*e. g.* fixation), bringing up the number of mercurial operations to nineteen.

It may be noted that the mixtures called *Vidas*, which potentially contained dilute mineral acids, were regularly employed not only in killing the metals (forming their oxides and chlorides), but—what is of fundamental importance—for purposes of chemical decomposition of metallic salts, etc. and the extraction and purification of metals.

Organic Compounds.—Organic Compounds are either vegetable or animal substances (खावर जडम मृत). The molasses, the fermented liquors, the saps and juices of plants, fruit acids, vegetable ashes and alkalis together with the tissues of plants are vegetable compounds (चौदित खावर मृत). Honey milk, curd, butter, fat, bile, urine, and other excreta, together with the organs and tissues of animals, are animal substances. Charaka notices vegetable as well as animal oils. The viscous (oily) substances are classed under four heads—butters, oils, fats, and marrows (सर्पिस्त्रैलं वसा मज्जा स्नेहो दृष्टवतुर्विधः). Salt may be either mineral or vegetable salt.

Susruta divides poisons into two classes—Vegetable and animal, but several poisons expressly termed mineral poisons (धातुविध) are included in the first class.

All organic substances, whether animal or vegetable, are penta-Bhautic, being compounded

of greater or less proportions of the five Mahā-bhūtas.

Taking the human body Charaka finds that the foetus is composed of sixteen organic substances, viz. four, composing the Sperm-cell which comes from the male; four composing the germ-cell which comes from the female; four added by the transformation of the nutritive material, and finally, four kinds of subtile matter, which together form the vehicle of the conscious principle. As to the four organic substances which compose the sperm-cell, or the other four which compose the germ-cell, it is not clear whether in Charaka's view they are also in their turn compounded of less complex organic substances, or whether their constituent elements are inorganic penta-Bhautic compounds.

The tissues that appear in the course of developments of the foetus are further transformations (higher compounds) of these foetal substances. All the component substances of the body are penta-Bhautic compounds, though sometimes they are assigned to the particular Bhūtas which predominate in their composition, *e.g.* bile to Tejas, lymph, chyle, blood, fat, urine, sweat and other secretions to Ap, and skin, flesh, bones, nails, hair, etc. to Earth.

(सृष्टं वायुमिन्द्रियवगुणपादवत् ।—गर्भस्य चत्वारि चतुर्विधानि भूतानि

मातापितृसन्धवानि चाङ्गारजानि चाक्लृप्तानि चैव et seq. Charaka, S'arīrasthāna, Chap. II. vide also Charaka, S'arīrasthāna, Chap. VII. cf. Gaṅgādhara's Jalpakaḷpataru. पितृं द्वितीयं भूतं शरीरारम्भकतेजःप्रधानपञ्चभूत-
विकारात्मकं तेजःस्वरूपमप्रिसृष्टम् । कफश्चतुर्थं भूतमापः शरीरारम्भकसीम-
प्रधानपञ्चभूतविकारविशेषः । शरीरं तु पञ्चमहाभूतविकारसमुदायात्मकम् ।
Cf. Charaka S'arīrasthāna, Chap. IV. मातृजादयोऽपि अस्म-
न्महाभूतविकाराः ।)

Fœtal Development (after Susruta). The ovum fertilised by the sperm-cell and developing under the influence of animal heat forms successive layers and tissues even as layers of cells and fibres are formed in wood. First are formed seven layers epithelial and dermal (सप्तत्वचः), then follow the several tissues (कलाः), the flesh, the vascular tissue, the fat and marrow, the lymphatic (and glandular) tissue, the intestinal tissues, the biliary and the seminal vessels,—tissues which are regarded by some as modifications of the original dermal layers of the ovum (cf. the layers of the blastoderm and their relation to the tissues in Embryology). The tissues are supposed to be developed successively, one out of another, by chemical action or metabolism (पाक), e. g. chyle is transformed into blood, blood into flesh, flesh into fat, fat into bone, bone into marrow, marrow into sperm-cell. The organs are next formed out of the tissues. The liver, gall-

bladder (क्लोम), spleen and lungs are referred to the blood ; the intestines to the blood, lymph and bile ; the kidneys to the blood and fat ; the testicles to the blood, lymph and fat ; the heart to the blood and lymph ; and the tongue to the lymph, blood and flesh. Vāyu, with the accompaniment of animal heat, impels the 'currents' (स्रोतसि) in the system ; Vāyu acting on the flesh gives rise to the muscles, and it is Vāyu again, which, with the essence of fat (or marrow), produces the nerves, arteries and tendons. (तस्य खलु यत्करोषितस्य अभिपच्यमानस्य शीरस्येव सन्तानिकाः सप्तलक्षो भवन्ति ।—कलाः खल्वपि सप्त सन्धवन्ति । यथाहि सारः काष्ठेषु हिद्यमानेषु दह्यते । तासां प्रथमा मांसधरा । द्वितीया रक्तधरा । तृतीया मेदोधरा । चतुर्थी श्लेष्मधरा । पञ्चमी पुरीषधरा । षष्ठी पित्तधरा । सप्तमी शुक्रधरा ।—गर्भस्य यत्कृत्योद्धानी शोणितजौ ।—et seq Susruta, Sārirasthāna, Chap. IV.—रसाद्राजं तवी मांसं मांसाभेदः प्रजायते । मेदसोऽसि तवी मज्जा मग्नः शुक्रस्य सन्धवः । Sūtrasthāna, Chap. XIV.)

The following parts (tissues and organs) in the foetus are in a special sense modifications of the four organic substances contributed by the sperm-cell of the male parent ; hair, nails, teeth, bones, nerves, veins and arteries, tendons and ligaments, and the sperm-cell ; the following, of the substances derived from the mother,—skin, blood

flesh, fat, the heart, liver and spleen, kidneys, stomach, intestines, etc. (Charaka, Sārirāsthāna, Chapter III. यानि सूक्ष्मस्य गर्भस्य पित्तजानि पित्ततः सम्भवतः सम्भवन्ति, तदयथा केश-यन्त्र-नख-लोम-दन्तास्त्रिशिरा-स्नायु-धमन्यः शर्ज-मिति पित्तजानि । यानि सूक्ष्मस्य गर्भस्य मातृजानि यानि च अस्य मातृतः सम्भवतः सम्भवन्ति—तदयथा त्वक् च लीङ्गितश्च मांसश्च मेदश्च हृदयं च यकृतं च प्रीक्षा च इक्षौ च पुरीषाधानं च आमाशयश्च इति मातृजानि ।)

Chemistry of Digestion—The food we eat contains five classes of penta-Bhautic organic compounds. From their radicles or predominant elements, the substances are named Earth-compounds, Ap-compounds, Tejas-compounds, Vāyu-compounds and A'kāsa-compounds. The Earth-compounds supply the hard formed matter of the body, the Tejas-compounds give the animal heat (or the metabolic heat), the Vāyu-compounds are the sources of the motor force in the organism, the Ap-compounds furnish the watery parts of the organic fluids, and the A'kāsa-compounds contribute to the finer etheric essence which is the vehicle of the conscious life. Roughly speaking, the Earth-compounds answer to the nitrogen compounds in the food, the Tejas-compounds to the hydro carbons (heat-producing) and the Vāyu-compounds to the carbo-hydrates (dynamic). The Ap-compounds are the watery parts of food

and drink. The flesh, for example, is a tissue composed principally of the Earth-compounds, the fat of the Earth and Ap compounds, the bones of Earth Vāyu and Tejas compounds. The Tejas compounds predominate in the composition of the blood. For purposes of digestion it is stated that different operations of the metabolic heat (perhaps different digestive fluids are also meant) are required to digest the different substances in the food.

The course of metabolism is described as follows :—The entire alimentary canal is called Mahāsrotas (the great channel).

The food goes down the gullet by the action of the biomotor force, the Prāna-Vāyu.

In the stomach (आमाशय) the food becomes mixed up first with a gelatinous mucus (फेसीमृत कर्क) which has a saccharine taste, and then gets acidulated by the further chemical action of a digestive juice (विदाह्यादञ्जता गतः)—evidently the gastric juice is meant. Then the biomotor force, the Samāna Vāyu, begins to act and drives down the chyle by means of the Grahani Nādi to the Pittāsaya (duodenum), into which bile comes down from the liver, and thence to the small intestines (the आमपक्वाशय). In these, the bile (or rather the digestive substance in the bile as opposed to the colouring element) acts on the chyme, and converts the latter into chyle (रक्त), which has at first

a Katu taste (pungency). This chyle contains in a decomposed and metamorphosed condition all the penta-Bhautic organic compounds, viz. tissue-producing Earth-compounds, water parts or Ap-compounds, heat-producing Tejas-compounds, force-producing Váyu compounds, and lastly, finer etheric constituents which serve as the vehicle of consciousness. The essence of chyle (सूक्ष्मभाग) from the small intestines is driven by the biomotor force, the Prána Váyu, along a Dhamaní trunk (cf. the thoracic duct) first to the heart (which is a great receptacle of chyle), and thence to the liver (and the spleen), and in the liver, the colouring substance in the bile acts on the essence of chyle, especially on the Tejas substance therein, and imparts to it a red pigment, transforming it into blood. But the grosser part of chyle (स्थूलभाग) proceeds along the Dhamanís, being driven by the biomotor force, the Vyána Váyu, all over the body.

When the blood has been formed, the essence of chyle in the blood, acted on by Váyu (biomotor force) and Mámságni (the flesh-forming metabolic heat), forms the flesh tissue, the Earth-compound of the food substance especially contributing to this tissue. Of the flesh tissue thus formed, the grosser part goes to feed or replenish the flesh tissue all over the body. The finer essence of flesh in the

blood in the chyle, acted on again by Vāyu (biomotor current) and the fat-forming metabolic heat (मिदोऽग्नि) in the menstruum of lymph (कफं समाश्रित्य), receives viscosity and whiteness, and produces the fatty tissue, the Earth-compounds and Ap-compounds of the food especially contributing to the product. This fat in the chyle (or blood), or rather the grosser part of it replenishes the fatty tissue of the body, but the finer essence of fat in the flesh in the blood in the chyle, acted on by Vāyu (biomotor current) and the marrow-forming metabolic heat, in the menstruum of lymph (द्वेषणाद्भव), becomes hard (or crystalline), and forms bone, the Earth, Vāyu and Tejas compounds contributing principally to the product. The essence of the fat fills the hollow channels of the bones, and acted on again by biomotor Vāyu and metabolic heat, becomes transformed into the marrow. The marrow is transformed into the semen, which is conveyed down by means of a pair of Dhamanīs (ducts) (द्वे शुक्रवाहके), lodged in its receptacles (शुक्रधरा—उदरयो) and discharged by means of another pair of ducts (द्वे विसर्गाय). The semen, or rather all the elements in their finer essence, give off Ojas, which returns to the heart, the receptacle of chyle and blood, and again floods the body, and sustains the tissues, thus completing the wheel (or self-return-

ing circle) of metabolism (परिवर्तितु चक्रवत्. Cf. Charaka and Vāgbhata).

It is to be noted that, throughout, the fluid in the chyle (or blood) acts as the menstruum, though occasionally the lymph, which is itself a derivative from the chyle is added as in the case of the fatty tissue and the marrow; and that each preceding element or constituent of the body (धातु-शरीररश्मिधातु) takes up the proper organic compounds from the food-chyle to form the next element or tissue. Throughout also, the chemical changes are due to the metabolic heat which breaks up the compounds and recombines, but the operations and even the vehicles perhaps of this heat are different. For example, these heat-corpuscles in the biliary ducts produce the bile, but the bile secretion is supposed to contain two distinct substances, (1) a digestive fluid in the duodenum (पित्ताशय) which acts on the chyme to produce the chyle, (अन्नस्य पक्वपाचकाख्यं पित्तं); and (2) a colouring bile substance in the liver which adds a red pigment to the chyle and transforms it into blood (रक्तकाख्यं पित्तम्). Besides, there are three other biles, of which the aqueous humour in the eye is supposed to be one (आक्षीपकपित्तम्) helping in the formation of visual images (रूपग्राहकम्). This is the view of Dhanvantari and his school, but A'treya holds there is no

evidence that the bile really performs the first (digestive) function, for this can be accounted for by the animal heat arising from the working of the whole bodily machine. There are three different hypotheses regarding the course of metabolism and the successive transformations of the chyle (चौरदधिव्याय-विदारौकुल्यान्याय-स्त्रलेकपोतन्यायेति विधा धातुदोष-जनः—Chakrapāni, Bhānumatī, Sūtrasthāna, Chap. 14, S'loka 10; also his commentary on Charaka, Sūtrasthāna, Chap. 28), but my account is based upon the second hypothesis which has the preference of Chakrapāni (चरकः). It may be added as a curiosity that each element of the body (धातु) under the metabolic heat is supposed to give off a finer essence (सूक्ष्मभाग) which serves as the material of the next succeeding element, and a dross (मल), which forms some of the excreta in the body (including the nails, the hair, etc.), besides retaining its own substance (the gross or main part) which is driven along by the Vāyus (biomotor or vital currents) or by the Srotas to its destination in the body. Some idea of circulation appears to have been entertained, for the heart which receives and then sends down the chyle through the Dhamanīs gets it back transformed into blood, and the Ojas also proceeds from the heart and returns to it along with the chyle and blood. (Cf. Vāgbhata—वाः इक्ष्वाः शिराः रसाज्जलं शोणः

अभिवदन्त्यः) । पचभूतात्मके दीर्घे आहारः पाचभौतिकः । विपक्षः
 पचथा सन्यग्गुणान् खानमिवर्द्धयेत् । *Susruta, Sūtrasthāna,*
Chap. 46. Cf. also विद्यत्पवनजाताभ्यां वृद्धिमाप्नोति मासतः ।
 आग्नेयमेव यदद्रव्यं तेन पित्तमुदीर्यते । *Ibid., Chap. 41.*
 मौमाण्याग्नेयवायव्याः पक्षीष्माणः सनाभसाः । पञ्चाहारगुणान् खान्
 खान् पार्थिवादीन् पचन्त्यतु । यथास्वं ते च पुच्छन्ति पक्ता मृत-
 गुणान् पृथक् । पार्थिवाः पार्थिवानेव श्रेष्ठाः श्रेष्ठाश्च दीर्घगान् ।
 अतिरिक्ता गुणा रक्ते बद्धेर्मंसि तु पार्थिवाः । मेदस्यपां भुवयास्त्रि
 पृथिव्यनिलतेजसाम् । *Charaka, quoted by Dalvana.* आदौ
 षड्रसमण्डलं मधुरीभूतमौरयेत्, फेणुभूतं कफं यातं विदाहादस्यतां
 ततः । वायुना समानाख्येन यक्ष्णीमभिनीयते । षष्ठी पित्तधरा नाम
 सा कला परिकीर्तिता । आमपक्वाशयान्तःस्था यक्ष्णी साऽभिधीयते ।
 अग्न्यधिष्ठानमद्रस्य यक्ष्णादयक्ष्णी मता । मुक्तमामाशये बद्धा सा
 विपाथ्य नयत्यधः । बलरत्नबला लघ्नमानमेव विमुञ्चति ।...अद्रस्य
 पक्त्वा पित्तान् पाचकाख्यं पुरीरितम् । दीपघातु-मलादीनामुद्मेत्या-
 नेयशासनम् ।...तेजीरसानां सर्वेषामम्बुजानां यदुच्यते । पित्तीक्ष्णा
 सरानिष रसो रक्तत्वसच्छति । वायुप्रितेजसा युक्तं रक्तं मांस-
 त्वमृच्छति । श्लेष्माणं च समाश्रित्य मांसं वाय्वग्निर्युतम्, स्फिरतां
 प्राप्य शीक्तां च मेदो दीर्घमिजायते । पृथिव्यग्निललादीनां सहातः
 श्लेष्णाहतः । खरत्वं प्रकरीत्यस्य जायतेऽस्त्रि ततो गृणाम् । करोति
 ततः सौविध्यमस्यां मध्ये समीरणः । मेदसा तानि पूर्यन्ते खेरो
 मज्जा ततः क्षृतः । तन्मान्मज्जश्च यः खेजः यक्तं संजायते ततः ।

Charaka—*Dridhabala Samhitā*, quoted by Aruna in his commentary on Vāgbhata. यथा किदारनिपतं कुल्याजलं मन्वासन्ना किदारोमाप्रावयति, तथा रस एव प्रथमं रक्तं प्रावयति। ततः रक्तस्थान-सम्बन्धात् रक्तसादृश्यं रक्तव्यपदेशं च चतुर्भवति। रक्तं च रक्तसमानेन स्त्रीकिंशोरेण 'अस्त्रं' पोषयति। ततो रक्तमाप्राव्य मांसमाप्रावयति, एवमुत्तरोत्तरधातून् रस एव प्रावयति। (Chakra-datta, Bhānumatī). This passage shows that the 'venous blood' was conceived to be chyle-essence mixed with blood, and that the circulation of the chyle so far as it was held to contribute its quota to the constituent elements and tissues of the body was really supposed to be identical with the circulation of the blood (ततो रक्तमाप्राव्य मांसमाप्रावयति). This will be abundantly clear from the following account of the course of the chyle and the blood :—

ततः सारभूतस्याहाररसस्य द्वौ भागौ भवतः। सूक्ष्मः सूक्ष्मः... ततः सूक्ष्मो भागः प्राणवायुना प्रेरितो धमनीमार्गेण शरीरारम्भकस्य रक्तस्य स्थानं यकृत्-शोष्करूपं गत्वा तेन सह मिलितो भवति। ततः प्राक्तन-रक्तधातौ एव तिष्ठति।.....ततः सारभूतस्य आहार-रसस्य द्वौ भागौ भवतः। सूक्ष्मः सूक्ष्मः। सूक्ष्मो भागो रज-काष्ठेन पित्तेन रक्तोक्तः शरीरारम्भकं रक्तं पोषयन् व्यान-वायुना प्रेरितो धमनीभिः संचरन् सखलशरीरगतानि रुधिराणि पुण्याति। ततः सूक्ष्मो भागः व्यानवायुना प्रेरितो धमनीभिः शिरानिधं शरीरारम्भकाणि मांसानि याति। et seq.

This finer essence of chyle which nourishes the flesh must also be carried in the blood, on the 'irrigation channel' hypothesis (केदारीकुल्यान्वाय). (For diagrams of the central circulation and the sympathico-spinal nervous system, *vide* my Paper on Hindu Anatomy and Physiology. The mechanism of life and the inheritance of specific and other congenital characters are also dealt with in the same paper).

Formation of molecular qualities in chemical compounds :—The Charaka school, which, we have seen, was an offshoot of the Sāṅkhya (cf. Charaka, Vimānasthāna, Chap. 8, यथा वादिन्यः प्रकाशकः तथा सांख्यधनं प्रकाशकमिति) supplemented the above account of inorganic and organic compounds with a characteristically Sāṅkhya explanation of the formation of molecular qualities by chemical combination. In Charaka's view, the colours, tastes, etc. of the molecules of chemical compounds result from the collocation in unequal proportion and unstable equilibrium of the different forces latent in the atoms (Paramāṇus) themselves. (एवमेतेषां रसानां षट्त्वमुपपन्नं नूनातिरेक-विशेषात् महामूलानां। मूलानामिव स्यावरजतमसानां नानावर्णाकृति-विशेषाः। Charaka.)

Chemistry of colours.—As an interesting example of the way in which a follower of Charaka would account for the colours of chemical compounds, I may note the explanation given by the late Gaṅgādhara Kavirāja Kaviratna in the *Jalpakaalpataru*, a commentary on the *Charaka-Saṁhitā*, published at Calcutta in 1869, premising that the Kavirāja's view is pure and genuine Charaka doctrine. Gaṅgādhara begins with a simple statement. The qualities of the atom, he writes, tend to produce similar qualities in the molecule. A molecular quality is therefore the result of the conjunction or opposition, as the case may be, of the atomic tendencies. When, for example, the five Bhūtas combine to produce an organic compound (the human body), Tejas, Ap and Earth tend to produce red, white and black respectively, but in the body (compound substance) the yellow colour may happen to be produced as the result of these tendencies in that particular proportion and collocation. The point to note here is that the molecule forms a fresh collocation, *redistributes the Mass and Energy*, and sets up new forces in the system which coming into play modify the potencies (or tendencies) in the component atoms and thus determine the resultant. This is elaborated into a curious but complete theory of the colours of chemical compounds.

The colours (and other qualities) of a simple substance (an isomeric mode of any Bhūta) are the result of the potencies lodged in that particular collocation of Mass, Energy and Essence. Now when two such substances unite, their colours etc. tend to be produced, but the combination brings on a fresh distribution of Energy, Mass and Essence, and the forces thus set free may powerfully modify or even extinguish the separate tendencies or potencies of the component simple substances. For example, when we prepare a collyrium by mixing equal parts of sulphur and mercury (the black sulphide of mercury), we find the resulting compound black. To explain this, it has to be remembered that each of the substances (sulphur and mercury), contains Sattva (Essence), Rajas (Energy) and Tamas (Mass) in different proportions, and that predominant Tamas (Inertia, Mass) always produces black, predominant Sattva (Essence) white and predominant Rajas (Energy) red. Now in the black sulphide of mercury, the white of the mercury tends to produce white and the yellow of the sulphur yellow ; and if these tendencies were not obstructed, the result would be a mixed colour. But, in the particular collocation in question, the Tamas of the mercury becomes intensive (तीव्र), and the black of the now intensive Tamas

extinguishes the white in the uncompounded mercury, which was due to prevailing Sattva, as well as the yellow of the uncompounded sulphur, which was due to the combined operation of white-producing Sattva and red-producing Rajas. Again, when, with proper apparatus and by the application of heat, we combine mercury and sulphur to produce the red sulphide of mercury, the resulting colour is explained by the fact that in this new collocation the Rajas (Energy)—probably of the mercury, though Gaṅgādhara does not specify—becomes intensive (*सौम्य*), and extinguishing both the white-producing Sattva of the mercury and the yellow-producing Sattva-Rajas of the sulphur, imparts a red colour to the compound. In these cases, as also in the formation of red by mixing powdered termeric with lime, i.e., whenever a new colour is produced in the compound it is to be explained by the dominance of Tamas, Rajas or Sattva, or their combinations, and the extinction of the uncompounded tendencies (or potencies) by the forces set free in the new collocation. But there are other cases where the colour of the compound is a mixed colour resulting from the colours of the combining substances, *e.g.*, when sulphide of mercury and calcined tin are mixed, the resulting colour is evidently a mixed one (Pātala, pink), which is

easily explained by the colours of the component elements (the red of the sulphide of mercury and the white of the calcined tin). In the same way, in a mechanical aggregate, as in a piece of cloth, the colour is white, where the threads are white.

(तत्कारणं पृथिव्यादिद्रव्यावस्थागुणा मन्वादयः खलु स्वस्व-
जातीयं गन्धविशेषादिकं आरभ्यमाणः शदारभ्यमाणं स्वस्वविजातीयं
कार्यं स्वारम्भकं कारणं अङ्गद्वारादिस्थं गुणांशं उभयथा
कुवचित् इत्वा कुवचित् न इत्वा स्वजातीयं गुणविशेषं आरभ्यते ।
यथा पारदगन्धकयोः संयोगे कञ्चलीमूतद्रव्ये पारदस्यः शुक्लः शुक्ल-
विशेषं आरभ्यमाणः गन्धकस्यपीतः पीतमारभ्यमाणः पारदस्यतोऽप्येन
तैश्च्यमारभ्यमाणेन विरोधिना बध्यते । सर्व्वेव शीक्षां सत्त्वगुणयोनि-
कं तमोगुणयोनि-कं तैश्च्येन विरोधिना बध्यते । गन्धकस्यपीतस्यै च
लोहितशुक्ली रजःसत्त्वयोनि-कौ बध्यते । तयोः शुक्लोहितवधे तैश्च्य-
समानयोनिः कृष्णः अभिव्यज्यते । इति पारदगन्धकोभयात्मकं कार्य्यं
त्रेतपीतमिलनेन सम्भाव्यं कार्य्यं यदवधे तत् तौष्ण्यगुणेन बध्यते,
तत्कारणं शुक्लोहितं इत्वा । एवं हिङ्गुले पारदगन्धकाभ्यामारभ्यमाणे
गन्धविशेषे वाङ्मना पच्यमाने रजोबहुसत्त्वयोनि-कं तौष्ण्येन सत्त्वतमो-
योनि-कौ शुक्लकृष्णौ बध्येते । पारदस्यशुक्लगन्धकस्यपीतमिलनेन सम्भाव्यं
कार्य्यं वधे च बध्यते । रजोयोनि-कलोहितं च अभिव्यज्यते इति ।
एवं हरिद्राचूर्णसंयोगेऽपि लौहित्यं अभिव्यज्यते चूर्णस्यतेऽप्येन हरिद्रास्य
शुक्लकृष्णवधे । अथ अथ यथा—हिङ्गुलवद्गन्धकसंयोगे त्रेतलोहित-
वर्णमेव उभयात्मकं भवति पाटलवधे, न च तत्र हिङ्गुलस्य

लोहितं वङ्गमम्लं शीतं च केनापि वध्यते। एवं यत्कस्य-
निर्मितपटलं शीतमेव।) (Jalpakaalpataṛu, Sūtrasthāna-
of Charaka, pp. 198-200; edition published
by Bhubanachandra Basāk, Calcutta, Samvāda-
ratnākara Press, Samvat 1925.) This is quite
in a line with Charaka's explanation of the tastes
of chemical compounds which has been already
noticed.

Parināma-vāda versus A'rambha-vāda : Charaka's
view of the formation of a new quality or a new
substance is based on the Sāṅkhya teaching as to
the conservation and transformation of Energy,
and brings chemical synthesis in a line with
evolutionary change (परिणाम). On this view, a
new substance may arise by spontaneous or isome-
ric change, i.e., by the inter-play of Energies within
the system of any given substance, in the absence
of any action from without. New qualities like
new substances are only readjustments of the
old, and continual changes are going on by
spontaneous disintegration and recombination.
Opposed to this evoluntional view of chemical
synthesis is the Nyāya-Vaiśeṣika doctrine of
A'rambha-vāda, according to which no change of
substance or quality, no effect, in short, can take

place except by the action of one component element (substance or quality) on another. A binary molecule, for example, cannot possess any 'specific quality' (विशेषगुण) of a kind not represented in each of the two component atoms. In the cosmic process, no atom can exist free and uncombined with another atom, and every 'specific quality' in a substance can be ultimately analysed into the union of two 'specific qualities' *of the same class* in two ultimate particles which cannot be further divided. A single colour, smell or taste in a single particle, until it can link itself on to another specific quality *of its own class* in a second particle, cannot characterise any substance formed by the union of these particles as material causes. Hence an Earth-atom cannot unite with an Ap-atom, to form a new substance of which both the particles must be equally regarded as material causes. At any rate, such a compound, if effected, would be smell-less, as of the two constituent atoms, only one, viz., the Earth-atom, possesses smell. A compound of Earth and Váyu would be smell-less, colourless and tasteless, and so on. The Nyáya-Vaiseshika does not deny that there may be compounds of different Bhútas, nor does it deny the causal operation of specific qualities as efficient or energising (dynamic) causes (उपपत्त्यक, निमित्तकारण) but it refuses to place

these compounds on the same footing as compounds of isomeric modes of the same Bhûta; and it accepts the 'material' causality, in such cases of only one of the Bhûtas, regarding the others as 'co-efficients' (निमित्तकारण).

The earlier Sāṅkhyas including the medical schools of ancient India brushed all this aside as a distinction without a difference. The Vedantists, as we shall presently see, flouted this doctrine of A'rambha-vāda. The Jainas, in opposing this Vaiseshika view of atomic combination, hit upon a solution of the problem of chemical affinity. Others again, found out a *via media*. They held, as we learn from the reports of Udyotakara in the Nyāya-vārtika, and of Vāchaspati Misra in the Tātparyyaśikā, that a molecule of the structure EA (one atom of Earth and one of Ap) would exhibit some variety of colour and taste resulting from the joint action of the atoms and of their several colours and tastes. But as in the combination EA only the Earth-atom possesses smell, and the Ap-atom is smell-less, and as moreover no quality in a compound substance can result except from the joint action of the similar (potential) qualities of at least two component elements, it follows that a molecule of the structure EA would not manifest the energy of smell potentially contained in the Earth-atom.

Hence, admitting the combination EA for a smell-less compound, the upholders of this view would suppose a molecule of the type E_2A (*i. e.* two atoms of Earth and one of Ap) to explain any bi-Bhautic compound of Earth and Ap (like the plant saps and fruit juices) which exhibits smell in addition to the peculiarities of colour and taste. (Cf. Vāchaspati's comment on Udyotikara's refutation of this view :—

अथमभिसन्धिः । पृथिव्याप्यपरमाणु तावन्नेकं द्वाणुकमारम्भस्य-
मर्द्धतः तयोः कपरकस्यशब्देन तदारम्भसम्भवे अपि गन्धवत्त्वा-
भावपसद्भात् । एवं पार्थिवान् समवेतस्य गन्धस्य एकत्वेन अनारम्भ-
कत्वात् नापि पार्थिवपरमाणुद्वयं एकस्य पाचनीयपरमाणुः इति
अणुनामारम्भकत्वे गन्धवत्त्वोपपत्तिः इति साम्प्रतं । परमाणूनां बहूनां
अनारम्भकत्वात् । तथाहि ययः परमाणवः न कार्यमारम्भते ।)

Measures of Time and Space. Size of atoms.

The Siddhānta-S'īromani gives the following measures of Time :—

30 Kshanas = 1 day, 2 Ghatikās = 1 Kshana,
30 Kalās = 1 Ghatika, 30 Kāshthās = 1 Kalā,
18 Nimeshas = 1 Kāshthā, 30 Tatparas =
1 Nimesha, and 100 Trutis = 1 Tatpara.

This makes a Truti of time equal to $\frac{1}{33720}$ of a second, which is nearly the measure of

the Paramānu of time; as given in the Vishnu-purāṇa (vide Bhāskara's Siddhānta-Sîromani—कालमानाध्यायः)।

The above measures were in use among the astronomers, but the physicists computed according to the following table given both in Udyana's Kiranāvali and S'riihara's Nyāyakandali :—30 Muhūrtas = 1 day (24 hours), 30 Kalās = 1 Mu-hūrta, 30 Kāshthās = 1 Kalā, 18 Nimeshas = 1 Kāshthā, 2 Lavas = 1 Nimesha, 2 Kshanas = 1 Lava.

सत्त्वयं लवः प्रोक्तो निमेषस्तु लवद्वयम् ।

अष्टादशनिमेषान्तु काला विंशतु ताः कला ।

विंशत्कला नुहर्षः स्यात् क्षिप्रद्राघादधी च ते ।

(Udayana, Kiranāvali).

This makes 1 Kshana of the Nyaya-Vaisesika equal to $\frac{1}{42}$ of a second. The Nyāya assumes that the unit of physical change (or the time occupied by any single antecedent step in a causal series before the succeeding step is ushered in) is equal to a Kshana (or $\frac{1}{42}$ of a second). The astronomers were familiar with far smaller measures of time. The astronomical Truti of time measures about the thirty-four-thousandth part of a second. This is of special value in determining the exact character of Bhāskara's claim to be regarded as the precursor of Newton in the discovery of the principle of the Differential Cal-

culus, as well as in its application to astronomical problems and computations. This claim, as I proceed to show, is absolutely established ; it is indeed far stronger than Archimedes's to the conception of a rudimentary process of Integration. Bhāskara in computing the "instantaneous motion" (तात्कालिकी गति) of a planet compares its successive positions, and regards its motion as constant during the interval (which of course cannot be greater than a Truti of time, though it may be indefinitely less). This tātkālika motion is no other than the differentia of the planet's longitude, and Bāpudeva Śāstrī claims that both the conception of the instantaneous motion and the method of determining it plainly show that Bhāskara was acquainted with the principle of the Differential Calculus. On the data before him, Mr. Spottiswoode remarks that Bāpudeva Śāstrī "overstates the case." Bhāskara "makes no allusion to one of the most essential features of the Differential Calculus, viz., the infinitesimal magnitude of the intervals of time and space therein employed. Nor indeed is anything specifically said about the fact that the method is an approximate one." "With all these reservations" Mr. Spottiswoode continues, "it must be admitted that the formula he establishes and the method of establishing it

bear a strong analogy to the corresponding process in modern mathematical astronomy" (*viz.*, the determination of the differential of the planet's longitude,—by no means the first step in transcendental analysis or in its application to astronomy). And Mr. Spottiswoode concludes by stating that mathematicians in Europe will be surprised to learn of the existence of such a process in the age of Bhāskara (*circa* 1150 A. D.—born 1114 A. D.). Mr. Spottiswoode's second objection that Bhāskara does not specifically state that the method of the Calculus is only approximative cannot be taken seriously. The conception of limit and the computation of errors came late in the history of the Calculuses of Fluxions and Infinitesimals. For the rest, Bhāskara introduces his computation expressly as a "correction" of Brahmagupta's rough simplification. The first objection (*viz.*, that Bhāskara makes no allusion to the infinitesimal magnitude of the intervals of space and time employed) would be more to the point, if it were well founded. But it is not, and Mr. Spottiswoode's error was due to the insufficiency of the data supplied to him. As a matter of fact, even Bhāskara's unit, the *Truti* of time (or *Paramānu*), is exceedingly small as the very name implies, being about one thirty-four-thousandth of a second of time. And in the passage in which Bhāskara describes the process, he distinguishes

between Sthúla-gati and Sūkshma-gati (velocity roughly measured, and measured accurately *i.e.*, by reference to indefinitely small quantities, for Sūkshma, as we have seen, has always a reference to the Anu, the indefinitely small). Indeed he expressly mentions that the Sthúla-gati takes only Sthúla-kāla (finite time) into consideration, and that the determination of the Tātkālikī Gati (Sūkshma-gati) must have reference to the moment (प्रतिक्षणम्), which is an indefinitely small quantity of time being of course smaller than his unit, the Truti. (Cf. इयं किल स्थूला गतिः अथ सूक्ष्मा तात्कालिकी कथ्यते.....यदा आसन्नस्तिव्यक्तस्तदा तात्कालिकया गत्या तिदिसाधनं कर्तुं युज्यते । तदा समीपचालनञ्च । यदा तु दूरतरस्तिव्यक्तः दूरचालनं वा अन्द्रस्य तदा आद्यया स्थूलया कर्तुं युज्यतेः स्थूलकालत्वात् । यतश्चन्द्रगतिः महत्त्वात् प्रतिक्षणं समा न भवति अतस्तदर्थे अयं विशेषीभिहितः ;—nothing can be clearer than this conception of 'momentary' motion.—Bhāskara, Siddhānta-S'iromani, Ganitādhyāya, Gatispṛatīprakaraṇa : cf. also प्रतिक्षणं सा न समा महत्त्वतः, *ibid.*, cf. also Golādhyāya, Tātkālikī-karana-vāsanā-prakarana, where Bhāskara points out that the mode of computing adopted by the A'chārya (Brahmagupta) is a rough simplification. The computation of relative motion and the idea of resolved components of motion were of course familiar to

the astronomers.—(Cf. एवं स्याच्चाख्येण लाघवाद्ये षट्चट्टी-
सम्बन्धिनी गतिकला चर्केप्रक्षिप्ताः। *ibid.*) I may add *en*
passant that Bhāskara's formula for the computation
of a table of Sines also implies his use of the
principle of the Differential Calculus.

Measures of weight and capacity. The Amara-
kosha mentions measures of three kinds—weight,
length and capacity (मानं तुल्यः षड्विंशतिः).

The *Krishnala* (*Guñjā*, *Raktikā*, the black and
red berry of the Shrub *Abrus Precatorius*) was
employed as a natural measure of weight. 80
Krishnala berries on the average weigh 105 grains
Troy, and this must be taken as the basis of our
computation, though in current practice 80 *Krish-*
nalas are taken to be equivalent to 210 grains.
One *Krishnala* was supposed to weigh as much as
3 medium-sized barley seeds (मज्जकण), one of
the latter as much as 6 white mustard seeds
(गौरसर्षप), one white mustard as much as 3 *Rāji*
mustard seeds (राजिसर्षप), one of these seeds as much
as 3 *Likshas*, and one *Liksha* as much as 8 *Rajas*
or *Trasareñus*.

We now come to conventional measures. One
gold *Māshā* was the weight of 5 *Krishnalas* of
gold, 1 *Suvarna* or *Tolā* weighed as much as 16
Māshās, and one *Pala* as much as 4 *Suvarnas* or
Tolās. A *Pala* of gold therefore weighs 320 *Krish-*
nalas (Manu, Chap. VIII, Vishnu, Chap. IV, and
Yājñavalkya, Chap. 1).

A Máshá of gold therefore would weigh $6\frac{2}{3}$ grains; a Tolá, 105 grains (in current practice it weighs nearly double as I have stated); and a Pala, 420 grains Troy.

The measures for silver were the following:—
1 Silver Máshá = 2 Krishnalas, 1 Dharana = 16 Silver Máshás and 1 Pala = 10 Dharanas. A Pala of silver would therefore weigh 320 Krishnalas. In other words, the Pala was a fixed measure of weight, and was equal to about 420 grains Troy, or double this, if we take the Krishnala of current practice.

A Pala, which equals 320 Krishnalas, was subdivided by 4, 16 and 5 successively for gold, and by 10, 16 and 2 successively for silver. A Suvarna (or Tolá) of gold corresponds roughly to a Dharana of silver, and a gold Máshá to a silver Máshá, but the sizes (or volumes) are not the same, and we must not therefore conclude that gold was supposed to be heavier than silver in the proportion of 5 to 2.

We find that 1296 Trasarenu equal 1 Krishnala. A Trasarenu, as a measure of weight, therefore, is the equivalent of $\frac{1}{1296}$ of a grain Troy or double this according to current measures.

But the Trasarenu of physics is a different conception. It stands for the *minimum visible*, i.e., as the physicists define it, that which is just discernible as a glancing particle in the slan-

ting beams of the morning (or afternoon) sun, coming into dark room through a chink or orifice of a window. This is a measure of size (or rather stimulus limen).

Measures of Capacity. Here the standard was furnished by the Kudava (कुडावा), a vessel described as 3 *Āṅgulis* long, 3 *Āṅgulis* broad, and $1\frac{1}{2}$ *Āṅguli* deep,—with a cubical capacity of $13\frac{1}{2}$ cubical *Āṅgulis*. 4 Kudavas = 1 Prastha, 4 Prasthas = 1 *A'dhaka*, 4 *A'dhakas* = 1 Drona, and 4 dronas = 1 *Khāri* or *Bhāra*.

24 *Āṅgulis* make 1 Hasta, cubit, which may be taken to be 18 or 19 inches. A Kudava was divided into 4 Palas, and there can be no doubt that originally water of the weight of 4 Palas was found to be actually contained in a vessel of the cubical capacity of a Kudava. If we take the ancient cubit to have been 19 inches, the Kudava would contain nearly 4 Palas of distilled water at 30 Centigrade. On a cubit of 18 inches, the Kudava would contain about $3\frac{2}{3}$ Palas.

The Kudava in current medical practice is supposed to represent a cubical vessel, each side being 4 *Āṅgulis*. This would give a capacity of 27 cubic inches, if we take the modern cubit of 18 inches. The Kavirājas take a Kudava to contain 8 Palas of water, and as 1 Pala = 320 *Krishnalas*, and 80 *Krishnalas* are now taken to be equal to 210 grains Troy, a vessel of a capacity

of 27 cubic inches is accordingly supposed to contain about 6720 grains Troy,—which is not very wide of the mark, being about 1·3 per cent short for distilled water at 86° Fahrenheit or 30° centigrade.

Size of the *minimum visibile* ; size of an atom.

The supposed thickness of the just discernible mote in the sunbeam called a Paramānu in Technology, S'ilpa-sāstra, (and a Trasarenu in Natural Philosophy, follows directly from Varāhamihira's table :—8 Paramānus make 1 Rajas (or Ratharenu,—cp. the Mānasāra), 8 Rajas make 1 Bālāgra (filament of hair), 8 Bālāgras make 1 Likshā, 8 Likshās make 1 Yūkā, 8 Yūkās make 1 Yava, 8 Yavas (the Mānasāra has 4) make 1 Anguli (superior), 24 Angulis make 1 Hasta (cubit, lesser cubit, 18 inches). The thickness of the *minimum visibile* (the finest perceptible mote in the slanting sunbeam) is therefore taken to be 3.2^{-20} or $\frac{1}{31250000000000000000}$ of an inch. The volume of a spherical Trasarenu (or Paramānu of the S'ilpa sastra) would therefore be $\frac{4}{3} \pi 3^{20} 2^{-60}$ of a cubic inch. It may be here noted that such a Trasarenu is supposed in the medical schools to contain 30 chemical atoms (Paramanus of Natural Philosophy) according to one estimate, or 60 according to another. The size of an atom must then have been conceived to be less than $\pi 3.5^{-1} 2^{-62}$ of a cubic inch.

परमाणुरणोदालावलिखदूकं यथोदुलं चेति अष्टगुणानि यथोत्तरम् अष्ट

मेकं भवति संख्या—Varāhamihira, *Vrihatsamhitā*, chap. 57, S'loka 2—जालान्तरगते भानौ यदन्तरं दर्शनं रजो याति तद्विद्यात् परमाणुं प्रथमं तद्वि प्रमाणानाम् । *ibid.*, S'loka I,—Cf. Utpala, तत्परमाणुं नाम प्रमाणं जानीयात् । प्रमाणानां सर्वेषां तत् प्रथममाद्यं प्रमाणं परमाणुसंज्ञम् । Cf. also, वसुरिण्डु विज्ञेयः त्रिग्रता परमाणुभिः) ।

The magnitude of a Paramānu is called *Pāri-māndalya* (पारिमाण्डल्य) in the *Nyāya-Vaisesika*, the name suggesting that the Paramānus were conceived to be spherical in shape. The *Nyāya-Vaisesika* calls a Paramānu a mere point without any dimensions, but in the *Sāṅkhya-Pātañjala*, a Paramānu, though indefinitely small, had still dimensions, being divisible into *Tanmātras*, which were themselves integrations of *Bhūtādi*. The diameter of a spherical Paramānu must have been conceived to be less than 3.2^{-20} of an inch (i.e. less than the conventional Paramānu with which linear measures begin), and the volume of a Paramānu would therefore, in accordance with *Bhāskara's* formula, be smaller than $\frac{4}{3}\pi.3^5.2^{-63}$ or $\pi.3^2.2^{-61}$ of a cubic inch where $\pi = \frac{22}{7}$. The *Tanmātras* were conceived as smaller still.

That these were conventional measures arbitrarily assumed goes without question, for, of course, the Hindus had no physical data for a mathematical calculation of these minute quantities. A *Bālāgra* (hair-tip, or finest filament of hair), for example, is taken to be 3.2^{-14} of an inch

thick, *i.e.* less than one five-thousandth fraction of an inch in thickness; and a fibril of the networks of Dhamanī or Nādí (nerve) that supply the pores of the skin (papillæ ? मुष्णानि रोमकूपप्रतिबद्धानि, Susruta) was supposed to be about a thousandth part of the finest hair in thickness, or $\frac{1}{1000}$ of the '*minimum visible*', and therefore about $3 \cdot 10^{-32-14}$ of an inch thick (cf. सूक्ष्मनाडीप्रचरति: रोमः सङ्ख्यमात्रेण तुल्यासु प्रचरति, Pañchadasī), but it is evident that these measures were arbitrarily fixed upon, instead of being arrived at by calculation or actual measurement. Indeed, Charaka expressly states that the number of S'irās and Dhamanīs in the body (three million fifty-six thousand nine hundred) is only a conjectural estimate अनिर्दिष्टमन्तः परं तर्कमेव—S'arīrasthāna, Chap. VII).

My account of the chemistry of the Sāṅkhya-Pātañjala, and of the affiliated Yoga and medical schools, has anticipated in several points the views of the Vedānta and the Nyāya-Vaiśeṣika. The chemical facts, processes and apparatus are indeed common to all the schools. In the following account of the chemistry of the schools other than the Sāṅkhya Pātañjala, I will confine myself to the theory of the subject, and even of this I will attempt only the briefest outline.

The Vedāntic view :—

The Vedāntists believe Māyā to be the 'material cause' (उपादानकारण) of the world. The power

of Mâyá is the power to realise the unreal—to impart practical Reality or mediate existence to that which does not and cannot possess absolute Reality or self-existence. Mâyá is at once real and unreal, while the Brahma (Self) is absolute Reality, absolute Intelligence and absolute Bliss. The world evolves out of Mâyá (मायापरिणाम) so that Mâyá in the Vedānta replaces the Prakṛiti of the Sāṅkhya. But Mâyá, and by implication the world, originate out of Brahma, not by a process of evolution (परिणाम), but of Vivarta (self-alienation). The self-alienation of the Absolute, acting through Mâyá, produces in the beginning A'kāśa, one, infinite, ubiquitous, imponderable, inert and all pervasive. The world thus begun goes on evolving, in increasing complexity. The other Sūkshma Bhútas, classes of subtile matter, evolve from A'kāśa, in an ascending linear order,—A'kāśa giving off Váyu, Váyu giving off Tejas, Tejas giving off Ap, and Ap giving off Earth. A'kāśa, one, infinite, all-pervasive, has the capacity of sound. Váyu, subtile gaseous matter, emanates from the universal A'kāśa and is instinct with the potential of mechanical energy (impact, pressure). ईरण, प्रणामित, वहन, व्युहन,—वायोश्च सर्व्व-वेष्टादितुल्येन सर्व्वविनाशतत्वात्—Vidvanmanorāñjiní). Tejas, subtile radiant matter, emanates from Váyu, and contains in potentia the energy of light and heat. Ap, subtile viscous matter, is the

transformation of Tejas, and is instinct with the energy that stimulates the nerve of taste, and lastly, Earth, subtile hard matter, which is the transformation of Ap, possesses the latent energy of smell.

But the subtile rudiments of matter must be compounded in various ways, to give rise to the gross constituent matter of the world. These forms of gross matter are called Mahábhútas. There are five kinds of Mahábhúta (gross matter corresponding to the five Sūkshma Bhútas (subtile matter, and the process by which a Mahábhúta is produced from the Sūkshma Bhútas is called Pañchákarawa (quintuplication). All the five Sūkshma Bhútas are present as ingredients, though in different proportions, in each Mahábhúta.

The Mahábhúta Earth, gross earth-matter, is composed of four parts of subtile earth-matter, and one part each of the other forms of subtile matter. The Mahábhúta Váyu is composed of four parts of subtile gaseous matter and one part each of the other forms of subtile matter. And similarly with other Mahábhútas.

Hence if ak, v, t, ap, e, represent the five forms of subtile matter (A'kása, Váyu, Tejas. Ap and Earth), and AK, V, T, AP, E, stand for the corresponding Mahábhútas, we may represent the constitution of the Mahábhútas as follows :—

$AK = ak_4. (v_1. t_1. ap_1. e_1)$, ak_4 being the radicle.

$V = v_4. (ak_1. t_1. ap_1. e_1)$, v_4 being the radicle.

$T = t_4. (ak_1. v_1. ap_1. e_1)$, t_4 being the radicle.

$AP = ap_4. (ak_1. v_1. t_1. e_1)$, ap_4 being the radicle.

$E = e_4. (ak_1. v_1. t_1. ap_1)$, e_4 being the radicle.

In forms of gross or compounded matter, the potential energies (or qualities) become actualised. The Mahābhūta Akāsa manifests sound; Vāyu, sound and mechanical energy; Tejas, sound, mechanical energy and heat-light; Ap, the energy of the taste-stimulus in addition; and finally Earth the energy of the smell-stimulus added to the foregoing.

The Pañchadaśī characterises the different Mahābhūtas by their typical sounds; *e.g.*, Akāsa by the echo (hollow booming sound); Vāyu (air) by a sibilant sound, hissing, susurration (imitative symbol, Visi); Tejas (fire) by a puffing (or roaring) sound (imitative symbol, Bhugubhugu); Ap (water) by a liquid sound (imitative symbol Culu Culu, gurgle, splash-splash, glut-glut); and finally Earth by a splitting or rattling sound, a crack or a thud (symbol, kad-kada)—Chap. II. Bhūtaviveka, S'loka 3, Pañchadaśī, cf. also Jayanta, Mañjarī.)

Others hold that Ākāśa, Ether, never enters as a component part, and is always one and indivisible. In this view, the four Mahābhūtas—Vāyu, Tejas, Ap and Earth alone are supposed to be com-

pounded, and by a process which may be called quaternion (cf. the Neo-Platonist quaternion) :—

$$V = v_3 (t_1 \cdot ap_1 \cdot e_1)$$

$$T = t_3 (v_1 \cdot ap_1 \cdot e_1)$$

$$AP = ap_3 (v_1 \cdot t_1 \cdot e_1)$$

$$E = e_3 (v_1 \cdot t_1 \cdot ap_1)$$

These compound forms, as before, are supposed to exercise their specific energies actively. Others again hold that the Mahābhūtas—Tejas, Ap and Earth alone are compounded by a process named Trivrit-karāṇa (triplication). Thus $T = t_3 (ap_1 \cdot e_1)$, $AP = ap_3 (t_1 \cdot e_1)$, $E = e_3 (t_1 \cdot ap_1)$.

The Sūkshma-bhūtas are forms of homogeneous and continuous matter, without any atomicity of structure; the Mahābhūtas are composite; but even these are regarded as continuous, and without any atomic structure. The Vedānta speaks of Anu (Paramānu) not as an ultimate indivisible discrete constituent of matter, but as the smallest conceivable quantum or measure of matter. In the Sāṅkhya doctrine, the atomic structure is ordinarily accepted. The Guṇas are supposed to be परिच्छिन्न and अणु bounded and indefinitely small in size (except the Guṇas giving rise to A'kāśa and Manas which are unlimited अपरिच्छिन्न); and hence the Tanmātras and Paramāṇus must be conceived to have a discrete structure.

As I have already noted in my account of the genesis of Tanmātras and Paramāṇus, various

schools of Vedāntists (*e.g.* the Rāmānujists and the followers of Nimbārka) combined, in the orthodox fashion of the Smṛitis and the Purāṇas, the Vedāntic theosophy with the Sāṅkhya cosmology especially as regards Prakṛiti and the order of creation and dissolution. For example, the Vedānta-kaustubhaprabhā, fortifying itself with texts from the Viṣṇu Purāṇa and the Subala and Gopāla Upanishadas, contends that at the cosmic dissolution (Pralaya), each Mahābhūta merges into the one that preceded it in the order of creation by first disintegrating into its own proper Tanmātric form (तन्मात्रद्वारा), and that the Mahābhūta A'kasa merges into the original Tanmātras, which then lapse into Bhūtādi, the supersubtile rudiment matter, proto-matter (Chap. II, Pada 3 Sutra 14).

Parināma—Evolutionary Process :—When the Mahābhūtas are once formed, the different kinds of substance are derived from them by the evolutionary process called Parināma (परिणाम, transformation). Matter is constantly undergoing change of state. The effect is only the cause in a new collocation (कारणस्यैव संस्थानमात्रं कार्यम्). Change is of two kinds :—

(1) Change by a spontaneous process, without external influence, including isomeric change (स्वाभाविक परिणाम). The Vedantists believe in

spontaneous disintegration and reintegration. Action from without, impressed force *ab extra*, is not, *pace* the Naiyávikas, always a condition of change of state (whether of rest or of motion);—nor is it necessary that more than one substance should combine to generate another substance or variety of substance (*e. g.* the formation of curds from milk, of ice from water *etc.*). All this is directed against the Nyáya doctrine (A'rambhaváda).

(2) Change due to combination with other substances (द्रव्यान्तरसंयोग). Such combination may produce (1) a compound substance possessing like qualities with the constituents (समानजातीयोत्पत्ति), or (2) unlike compounds with new qualities, "heteropathic effects" (विजातीयोत्पत्ति). Any new quality thus evolved through (chemical) combination is called Samhata-bhúta-dharma संवृतभूतधर्म), *e. g.* the intoxicating power of the fermented rice and molasses, which does not exist in the ingredients taken separately. (मद्यबीजानां प्रत्येकं अवर्तमानाणि समुदायशक्त्या मदशक्तिः दृश्यते). This Sambhúyakriyā (सम्भूयक्रिया, समुत्पन्न) corresponds to chemical combination, and the Vedantists, like the Sāṅkhyas, explain this only as the evolution of the latent energy (शक्ति, अनुद्भूतशक्ति) in a new collocation (संज्ञान, अवयव-संनिवेश). But, unlike the mediæval Sāṅkhya, the Vedānta freely recognises the com-

bination of heterogeneous Bhútas. Thus, Earth, Ap, Tejas and Vāyu freely combine in different proportions and groupings to produce the variety of substances in the world. For example, the animal organism is a compound of all the five Bhútas (पञ्च-भौतिक). It is not merely the concomitant or efficient causes that may be heterogeneous to the material cause, as the Naiyāyikas contend, but several heterogeneous substances or (Bhútas) may unite as 'material causes' to produce a new substance.

The Vedantists resolve all activity, physical, vital as well as psychical, into modes of motion, subtile cosmic motion (परिस्पन्द, सर्वलोकपरिस्पन्द—S'aṅkara ; वायोः परिस्पन्दात्मकत्वात्,—प्राणस्य परिस्पन्दात्मकत्वादिव—यद्वत् तं स्थूलं सूक्ष्मं च तत्सर्वं मनःस्पन्दितमात्मन्—S'aṅkara); but they give a separate substantive existence to the agents, the vital principle (प्राण) and the mind (मनः), though these are also evolutionary transformations of the Sūkshma Bhútas (forms of subtile matter). What is common to the Nyāya, the Vedānta and the Sāṅkhya is that Consciousness or Intelligence (चैतन्य) transcends Matter ; but the Naiyāyikas as pluralists hold that vital and psychical activities are also immaterial and cannot be resolved into motion (परिस्पन्द);—the Vedāntists resolve these activities into subtile motion, but

ascribe them to a substantive quasi-material Life Principle and Mind, the all-mirroring Intelligence (चेतन) alone being immaterial and transcendent : and the Sāṅkhyas accept the substantive existence of the Mind principle (मनः) as derived co-ordinately with the Sūkshma Bhūtas or Tanmātras from individualised prakṛiti (Ahankāra), but resolve Life into a mere resultant activity of the bodily organs, viz. the organs of sense and movement, and the psychic principle (मनः).

पञ्चीकरणः—द्विधा विधाय चैकेकं चतुर्धा प्रथमं पुनः ।

सस्वेतरद्वितीयमिदं योजनात् पञ्च पञ्च ते ।

यथा निसर्गश्रुतौ सृष्टानां भूतानां स्फुटतरव्यवहारनामरूपस्य करणोपायतया विवृत्करणं श्रुतं तद्वत् सूतपञ्चकसर्गश्रुतौ अपि तथा । तदानीं पञ्चीकरणान्तरं आकाशशब्दोऽभिव्यज्यते स्फुटतयेति सर्वत्र योजनीयं (विद्वन्मनीषिणी)—अस्ति हि शरीरे सर्वेषामपि भूतानां कार्यसंप्रतिपत्तिः अवकाशव्यूहपवनहृदनकाठिन्यानां सर्वजानामुभवसिद्धत्वात् । अतस्तत्कारणतया पञ्चानि भूतानि एकस्मिन् देहे सन्तीति स्थिते तनुपट्योरिव अवयवावयवित्वमेव पञ्चभूतदेहयोर्युक्तं । न च स्पर्शश्रुत्यत्वात् एकद्रव्यत्वात् च आकाशस्य आरम्भकत्वानुपपत्तिरिति वाच्यं । आरम्भवादस्य अनङ्गीकारात् । एकस्यापि दुग्धावयविनी दध्मारम्भकत्वदर्शनात् । वस्तुतस्तु पञ्चानां भूतानां पञ्चात्मकत्वस्य दर्शितत्वात् आरम्भवादस्य निराकृतत्वात् च । तस्मात् सिद्धं शरीरं पाञ्चभौतिकमिति । Vidvanmanoranjanī.

न तावत् समानजातीयमेव चारभते न भिन्नजातीयमिति नियमो नास्ति । समवायिकारणे एव समानजातीयत्वाभ्युपगमः न कारणान्तर-विषय इति तदपि अनेकान्तिकम् । नापि अनेकमेव चारभते नैकमिति नियमोऽस्ति । अष्टमनसोराद्यकर्मकारणाभ्युपगमात् । एकैकी हि परमाणु-द्वार्यं स्वकर्मभते न द्रव्यान्तरैः संश्लेष इत्यभ्युपगम्यते । द्रव्यारम्भे एव अनेकारम्भकत्वनियम इति चेत् न परिणामाभ्युपगमात् । तदेव तु द्रव्यं विशेषवदवस्थान्तरं आपद्यमानं कार्ये नामाभ्युपगम्यते । तच्च कश्चित् अनेकं परिणमते सूक्ष्मजातुरादिभावेन, कश्चिदेकं परिणमते सौरादि-द्रव्यादिभावेन । नैश्चर्यासनं अस्ति अनेकं एव कारणं कार्ये जनयति इति । Sāṅkara, Śāriraka bhāṣhya, Sūtra 7, Pada 3, Adhyāya II).

The atomic theory of the Buddhists :—The Vaibhāṣhikas and the Sautrāntikas hold that the Vāyu-atoms are touch-sensibles, having impact or pressure for their characteristic property, and by aggregation from the element Vāyu; the Tejas-atoms are colour-and-touch-sensibles, having heat for their characteristic, and by aggregation from the Tejas Bhūta; the Ap-atoms are taste-colour-and-touch-sensibles with a characteristic viscosity, and form the Ap-element by aggregation; and finally the Earth-atoms are smell-taste colour-and-touch-sensibles possessing a characteristic dryness or roughness (खरत्वं), and by their aggregation form the Earth-element, The Bhūtas

thus originated combine to form aggregates, which are classed as inorganic substances, organisms and organs. (कामेऽष्टद्रव्यकोऽष्टः—Udyotakara's extract from the Buddhist Sūtras, Nyāya Vārtika. Chap. I. A'hnika 1, Sūtra, 14. of. Vāchaspati's fuller extract :—कामे षष्टद्रव्यकोऽष्टारण्यः रूपधातुररूपधातुः कामधातुः—also the Buddhist commentary :—कामे कामधातो षष्टद्रव्यकः षष्ठः । रूपरसगन्धस्पर्श इति चत्वारि द्रव्याणि पृथिव्यप्तेजीवायुः इति चत्वारि—Vāchaspati. Tātparyyaśikā. loc. cit.—also खरवेद्योषेरणसभावाणि भूतानि—vide Udyotakara, Chap. III, A'hnikā 2, Sūtra 12,—Vide also Śrīnivāsa's Vedānta-kaustubha, Chap. II, Pada 2. Sūtra 18).

The atomic theory of the Jainas :—Of the nine categories of the Jainas, that of Ajīva (the not-soul or non-Ego) consists of five entities, four of which are immaterial (अमूर्त), viz., merit, demerit, space and Time, and the fifth, material (मूर्त, possessing figure). The last is called Pudgala (matter), and this alone is the vehicle of Energy, which is essentially kinetic, i.e. of the nature of motion. Everything in the world of not-soul (the non-Ego) is either an entity (द्रव्य), or a change of state in an entity (पर्व्याय). Pudgala (matter) and its changes of state (पर्व्याय), whether of the nature of subtile motion (परिच्छन्द) or of Evolution (परिव्रान), must furnish the *physical* as opposed to the *metaphysical* basis of all our explanations of Nature. Pud-

gala (Matter) exists in two forms,—Anu (atom) and Skandha (aggregate). The Jainas begin with an absolutely homogeneous mass of Pudgalas, which, by differentiation (भेद) breaks up into several kinds of atoms qualitatively determined, and by differentiation, integration, and differentiation in the integrated (संघातात्, भेदात्, संघातभेदात्—Umāsvātī, Chap. V, Sūtra 26), forms aggregates (Skandhas). An Anu has no parts, no beginning, middle or end. An Anu is not only infinitesimal, but also eternal and ultimate. A Skandha may vary from a binary aggregate (द्वययुक्त) to an infinitum (अनन्तायुक्त). A binary Skandha is an aggregate of two Anus (atoms), a tertiary Skandha is formed by the addition of an atom (Anu) to the binary (द्वययुक्त) and so on *ad infinitum*. The ascending grades are (1) what can be numbered (संख्येय), (2) indefinitely large (असंख्येय), (3) infinity of the first order (अनन्त), (4) infinity of the second order (अनन्तानन्त), and so on.

General Properties of Matter :—

The specific characters of the Pudgalas (Matter) are of two kinds, (1) those which are found in atoms as well as in aggregates, and (2) those which are found only in aggregates. Qualities of touch, taste, smell and colour come under the first head.

The original Pudgalas being homogeneous and indeterminate, all sensible qualities, including the infra-sensible qualities of atoms, are the result of evolution (परिणाम). Every atom thus evolved possesses an infra-sensible (or potential) taste, smell and colour, (one kind of each) and two infra-sensible tactile qualities, *e.g.* a certain degree of roughness or smoothness (or dryness and moistness?) and of heat or cold. Earth-atoms, Ap-atoms, *etc.* are but differentiations of the originally homogeneous Pudgalas. The tactile qualities (स्पर्श, दृश्य, चक्षु, श्रोत) appear first, but qualities of taste, smell and colour are involved in the possession of tactile qualities. An aggregate (Skandha), whether binary, tertiary or of a higher order, possesses (in addition to touch, taste smell, and colour) the following physical characters:—(1) sound, (2) atomic linking, or mutual attraction and repulsion of atoms, (3) dimension, small or great, (4) figure, (5) divisibility, (6) opacity and casting of shadows, and (7) radiant heat and light.

Sensible qualities. Tactile qualities are of the following kinds—hardness or softness, heaviness or lightness (degrees of pressure), heat or cold, and roughness or smoothness (or dryness and viscosity?). Of these, the atoms (Anus) possess only temperature, and degrees of roughness or smoothness, but

all the four kinds of tactile qualities in different degrees and combinations characterise aggregates of matter from the binary molecule upwards. The Jainas appear to have thought that gravity was developed in molecules as the result of atomic linking. Simple tastes are of five kinds,—bitter, pungent, astringent, acid and sweet. Salt is supposed by some to be resolvable into sweet, while others consider it as a compound taste. Smells are either pleasant or unpleasant. Mallishena notes some elementary varieties of unpleasant smell, *e.g.* the smell of asafœtida, ordure, *etc.* The simple colours are five—black, blue, red, yellow and white. Sounds may be classed as loud or faint, bass (thick) or treble (hollow), clang or articulate speech.

The most remarkable contribution of the Jainas to the atomic theory relates to their analysis of atomic linking, or the mutual attraction (or repulsion) of atoms, in the formation of molecules. The question is raised in Umāsvāti's Jaina Sūtras (circa A. D. 40)—what constitutes atomic linking? Is mere contact (or juxtaposition) of atoms sufficient to cause linking? No distinction is here made between the forces that bind together atoms of the same Bhūta, and the chemical affinity of one Bhūta to another. The Jainas hold that the different classes of elementary substances (Bhūtas) are all evolved from the same primordial atoms.

The intra-atomic forces which lead to the formation of chemical compounds do not therefore differ in kind from those that explain the original linking of atoms to form molecules.

Mere juxtaposition (संवीन) is insufficient; *linking* of atoms or molecules must follow before a compound can be produced. The linking takes place under different conditions. Ordinarily speaking, one particle of matter (द्रव्य) must be negative, and other positive (विपक्षगुणयुक्त); the two particles must have two peculiar opposite qualities, roughness and smoothness (रुचल and शिथल or dryness and viscosity?), to make the linking possible. But no linking takes place, where the qualities, though opposed, are very defective or feeble (जडगुण). We have seen that, ordinarily speaking, two homogeneous particles, *i.e.* both positive, or both negative, do not unite. This is the case where the opposed qualities are equal in intensity. But if the strength or intensity of the one is twice as great as that of the other, or exceeds that proportion, then even similar particles may be attracted towards each other. In every case, change of state in both the particles is supposed to be the result of this linking, and the physical characters of the aggregate depend on the nature of this linking. When particles of equal intensity (negative and positive) modify each

other, there is mutual action ; in cases of unequal intensity, the higher intensity transforms the lower, it being apparently thought that an influence proceeds from the higher to the lower. All changes in the qualities of atoms depend on this linking. A crude anticipation this, of the ionic theory of chemical combinations, very crude but immensely suggestive, and possibly based on the observed electrification of smooth and rough surfaces as the result of rubbing. The interpretation of दृक् and स्निग्ध as dry and viscous (or as vitreous and resinous ?) must be rejected in this connection as untenable. The Tattvārthādhigama of Umāsvāti, which expounds the theory, most probably dates back to the first half of the first century A. D. Cf. Umāsvāti—Tattvādhigama, Chap. V.

(अजीवकाया धर्माधर्माकाशपुद्गलाः । द्रव्याणि जीवाश्च । निम्ना-
वस्थितानि अरूपाणि । रूपिणः पुद्गलाः । आकाशादिकद्रव्याणि ।
निष्क्रियाणि च । पुद्गलजीवान् क्रियावन्तः । (क्रियेति गतिकर्माह) ।
सर्वेषां प्रदिशाः सन्ति अन्यत्र परमासीः । सर्वेषांसंख्येयाश्च पुद्गलानां ।
नासीः । स्पर्शरसगन्धवर्णवन्तः पुद्गलाः । तत्र स्पर्शोऽष्टविधः कठिनी
मृदुगुरुदुर्लघुः शीत उष्णः स्निग्धः दृक् इति । रसः पञ्चविधस्तप्तः
कटुः कषायोऽम्ली मधुर इति । गन्धी द्विविधः सुरभिरसुरभिश्च । वर्णः
पञ्चविधः कृष्णो नीलो लोहितः पीतः शुक्ल इति ।

शब्दवत्त्वसौख्यसौख्यसंस्मानभेदतमन्त्रायातपोद्योतवन्तश्च । तत्र शब्दः
शब्दविधः ततो विततो घनः शुश्रिरो वर्धो भाव इति । अथवाः

स्तम्भाय । उत्तं च । कारणमेव तदन्वयं सूचीं नित्यं भवति परमाणुः ।
 एकरसमन्वयार्थं द्वितीयः कार्यलिङ्गश्च । तत्राचरोऽवस्थाः स्तम्भास्तु बद्धा
 एव । स्तम्भास्तावत् संघातभेदेभ्य उत्पद्यन्ते । संघातभेदादिति । द्वयोः
 परमाण्वोः संघाताद्भिप्रदेशः । द्विप्रदेशस्याधीय संघातात् विप्रदेशः ।
 एवं संख्येयानामसंख्येयानामनन्तानां अनन्तानन्तानां च प्रदेशानां
 संघातात् प्रदेशाः । भेदादयः । भेदादेव परमाणुवत्पद्यते न
 संघातादिति । अत्राह । किं संयोगमात्रादेव संघातो भवति ।
 आसीदिति कश्चिद्विशेष इति । अत्रोच्यते । सति संयोगे बद्धस्य
 संघातो भवतीति । सिग्धरुच्यत्वाद्भवः । न अघन्यगुणानाम् । सिग्ध-
 रुचयोः पुद्गलयोः सृष्टयोर्वन्धो भवतीति । अघन्यगुणसिग्धानां
 अघन्यगुणरुचाणां च परस्परं वन्धो न भवतीति । उत्तं भवता
 अघन्यगुणवर्णानां सिग्धानां रुचेण रुचाणां च सिग्धेन सह वन्धो
 भवतीति । अथ तुल्यगुणयोः किमन्वयप्रतिषेध इति । अत्रोच्यते ।
 न । गुणसाम्ये सहग्रानां । गुणसाम्ये सति सहग्रानां वन्धो न भवति ।
 तदयथा । तुल्यगुणसिग्धस्य तुल्यगुणसिग्धेन तुल्यगुणरुचस्य तुल्यगुण-
 रुचेण इति । अत्राह सहग्रयणं किमपेक्षते इति । अत्रोच्यते ।
 गुणवैषम्ये सहग्रानां वन्धो भवति इति । अत्राह किमपेक्षितं गुण-
 वैषम्ये सहग्रानां वन्धो भवतीति । अत्रोच्यते । वायुकादिगुणानां
 तु वायुकादिगुणानां सहग्रानां वन्धो भवति । द्विगुणाधिकसिग्धेन ।
 द्विगुणाधिकसिग्धस्य सिग्धेन । रुचस्यापि द्विगुणाधिकरुचस्य
 रुचेण । एकादिगुणाधिकयोस्तु सहग्रयोर्वन्धो न भवति । अत्राह
 परमाणुषु स्तम्भेषु च ये स्यादयो गुणास्ते किं व्यवस्थिताः तेषु

आद्योच्छिदव्यवस्थिता इति । अवोच्यते । अव्यवस्थितायुतः । परिणामात् ।
 अत्रापि इदोरपि बध्यमानयोर्गुणवत्त्वे सति कथं परिणामी भवति इति ।
 उच्यते । वन्मे समाधिकौ पारिणामिकौ । वन्मे सति समगुणस्य
 समगुणः परिणामिको भवति । अधिकगुणो ह्येनस्येति । Umāsvāti,
 Tattvārthadhigama, Chap. V).

The Nyāya-Vaisheshika chemical theory : a brief summary.

I must content myself here with a brief and rapid sketch of the chemistry of the Nyāya-Vaisheshika, which I shall elaborate in connection with the mechanics and physics of the ancient Hindus in a separate paper.

The relation of the specific characters of molecules (and higher aggregates) to the original atomic qualities is reduced in the Nyāya-Vaisheshika to the following canons :— (a) कार्यगुणं कारकगुण-पूर्वकम् । (b) समानजातीयसंयोगः द्रव्यारम्भकः न विजातीयसंयोगः

(Here, द्रव्य is used in a narrow technical sense, so as to exclude the quasi-compound sub-stances).

(c) अपाकजडपरसमन्वयशर्मापरिमाणौ कलैकपुत्रजगुहलद्रवत्वस्येद्वेगाः कारकगुणपूर्वकाः । (d) जडपरसमन्वानुपस्थानशब्द-परिमाणौ कलैकपुत्रजस्येहाः

समानजात्यारम्भकाः । No separate explanation is necessary, as the canons are embodied in the following exposition.

Theory of Atomic combination :—

The four kinds of Atoms are Earth, Ap, Tejas and Vāyu atoms, possessed of characteristic mass, numerical unit, weight, fluidity (or its opposite), viscosity (or its opposite), velocity (or quantity of impressed motion—Vega); also characteristic potential colour, taste, smell or touch, not produced by the chemical operation of heat अपाकज-रूपरसगन्धस्पर्शपरिमाणैकत्व-पृथक्-गुणत्वद्रव्यस्यैवदेवाः). A'kāśa has no atomic structure (निरवयव), and is absolutely inert (निष्कृष्ट), being posited only as the substratum of sound, which is supposed to travel wave-like in the manifesting medium or vehicle of Vāyu (air). Only the other four Bhūtas unite (or disunite) in atomic or molecular forms. The orthodox view is that, the presence of Earth-atoms is necessary whenever chemical transformation under the operation of heat (पाककोत्पत्ति) takes place.

Atoms cannot exist in an uncombined state in Creation (Sivādityā, Sapta-padārthī—*Vide* commentary, where, however, it is noted that still atmospheric air is believed to be monatomic in structure, i. e. to consist of masses of atoms in a loose uncombined state—(क्षिप्तितवायुस्तु परमाणुसमूह एव अनात्म-द्रव्यः ।

The atoms may combine in one or other of the following ways :—

1. One Earth-atom, by an original tendency, unites with another, to form a binary molecule (द्वयचुच्च). In the same way, binary molecules of the other Bhūtas are formed. The atoms are possessed of an inherent Parispanda (rotary or vibratory motion), and when they unite in pairs, *so long as there is no chemical operation under the action of heat corpuscles*, the original qualities of the atoms produce homogeneous qualities in the binary molecules.

The question as to the existence of a triad, a tetrad, a pentad *etc.* of atoms is one of the moot points of the Nyāya-Vaiśeṣika. The orthodox view is that, the primordial infinitesimal particles (atoms) start with an incessant vibratory motion अनवरतपरिस्पन्दमानापरिमितपवनादिपरमाणवः, Raghunātha S'iro-maṇi—गतिशूलत्वात् पतन्नव्यपदेशाः पतन्तीति, Udayana, Kusu-māñjali), and an inherent impulse that drives them to unite in pairs—a sort of 'monovalency', *as it were*, exhausted with the formation of a binary molecule. The binary molecules now combine by threes, fours, fives, *etc.* to form larger aggregates as well as the variety of elementary substances, the particular collocation in any case being not only determined by physical causes, but also serving to satisfy the ends of the moral Law in creation (चङ्कट, कर्ण), (द्वयचुच्चैर्बहुभिरारभ्यते इत्यपि नियमो,

न द्वाभ्यां । बहुषु त्वनियमः । कदाचित् विभिरारभ्यते इति । वायुकमिन्युच्यते, कदाचित्तुर्भिरारभ्यते कदाचित् पञ्चभिरिति यदेष्टं कल्पना । अदृष्टवशात् तथा तथा तेषां व्युत्पत्तिरिति यथा यथा तदारब्धेषु अपरजातयोः व्यवस्थे । अदृष्टकारिता सर्वभाषाणां सृष्टिः । S'ridhara, Nyāya-Kandali, इतिदीनिदपचम् ।) Cf. Vāchaspati's report, Bhāmatī, Chap. II., Pada II. Sūtra II. यदा चतुरशुकमारभते चतुर्षां वायुकानामारम्भकत्वात् । Prasastapāda appears to have originated this view (परमाणुवायुकैश्च बहुलघंक्षा तैरारब्धे वायुकादिस्तस्यै—Prasastapāda, परिमाण निदपचम्); but that another view was also maintained in the Vaisesika School is evident from the brief summary of Kanāda's system given in Utpala's commentary on the Vrihatsambhitā, and this indeed also follows from S'ridhara's admissions in the Kandali. On this view, also, atoms have an inherent tendency to unite, but some unite in pairs, others in triads, others in tetrads, etc. This may happen in two ways,—either by the atoms falling into groups of threes, fours, etc. direct, or by the successive addition of one atom to each preceding aggregate.

A triad (Tryanuka), then, holds together three atoms (Anus), not three binary molecules (Dvyanukas) as on the orthodox hypothesis. Similarly with tetrads, pentads etc. चतुर्विधाः परमाणवः स्थितिजलाघिनायुनाम् ।

शब्दां परमाणुभ्यां द्वाकमारभ्यते त्रिभिः परमाणुभिश्चाष्टकमारभ्यते इति क्रमिण्यष्टककार्यं द्रव्यस्वीत्पत्तिः । Utpala, Chap. 1. S'lōka 7 ; cf. also S'rīdhara's admission, अथवा यदि परमाण्वी द्वाकमारभ्य तत्सहितैस्त्रयाष्टकमारभ्यते चाष्टकसहितैस्तु द्रव्यान्तरम् तथापि कुतो विद्वस्य अष्टकम्). S'aṅkara seems to speak of two binary molecules in the Vaiseshika as forming a tetrad, (यदापि वै द्वाष्टुके चतुरष्टकमारभ्यते—S'āṅkara-Bhāṣhya, Chap. II, Pada Sūtra, II, where the Bhāmntī gives a forced interpretation).

In Prasastapāda's view, these binary molecules are grouped by threes, fours, fives *etc.* (द्वाष्टक, चतुरष्टक) to form different isomeric modifications. The variety of Earth-substances is due to differences in the arrangements of the molecules (*e.g.* their greater or less density, and, above all, their grouping or collocation अष्ट, अवयवसन्निवेश), which account for the specific characters (अपरजाति) manifested by these isomeric substances. सा पृथिवी च स्यैर्व्याद्यवयवसन्निवेशविशिष्टा अपरजातिवहुलोपेता । Prasastapāda, पृथिवीनिरूपणम् । स्यैर्व्यै निविबुद्धम् । आदिमन्दात् प्रशिथिलत्वादिरिदम् । परमाण्वादिषु अपरजातमावेदपि अदृष्टवशात् तथा तथा तेषां व्युद्भूतः यथा यथा तदारब्धेषु अपरजातयो व्यज्यन्ते । S'rīdhara, Kandalī, *ibid.*

स्यैर्व्यै स्मिरता चिरकालावस्थायित्वमिति यावत् । आदिरिदं आदिष्टककालं जलादिव्युद्भवीरीधित्वम् । अवयवसन्निवेशाः तत्तत्सामान्यविशेषाभिव्यक्तक-

संस्मानविशेषाः । न हि एतद्द्रव्यान्तरं सम्भवति । जलादीनां यत्किञ्चित्-
 स्पर्शवद्भेदवद्द्रव्योपनिपातमात्रेणैव भङ्गुरत्वात् । Udayana, Kiranā-
 vali, *ibid.* These original differences in molecular
 grouping leading to distinctions of genera and species,
 however mechanically or physically explained, come
 also under the operation of moral and metaphysical
 causes (चतुष्टयं, चतुष्टयं), i.e., of ideal ends in the moral
 government of the universe, which are superimposed
 upon the physical order, but which do not come
 within the scope of Natural philosophy. An elemen-
 tary substance thus produced by primary atomic com-
 bination, may, however, suffer qualitative change
 under the influence of heat (पाञ्चभोजोत्पत्तिः). The pro-
 cess is as follows :—(1) the impact of heat corpuscles
 decomposes the binary (tertiary; or quaternary) mole-
 cules into homogeneous atoms possessing only the
 generic characters of the Bhūta concerned ;—(2) the
 impacts of heat particles continue, and transform the
 characters of the atoms; determining them all in
 the same way ;—(3) the heat particles continue to
 impinge, and reunite the atoms so transformed to
 form binary (or other) molecules, in different orders
 or arrangements, which account for the specific
 characters or qualities finally produced. The Vaise-
 shika holds that there is decomposition into

homogeneous atoms, transformation of atomic qualities, and finally recombination, all under the influence of heat. The Nyāya on the other hand thinks that the molecules and larger aggregates assume the new characters under the influence of heat without decomposition into homogeneous atoms, or change of atomic characters (पिलुपाक or पिटरपाक).

तेषामनुमानेन विनाशः परिकल्पते। सञ्जावयवेषु अन्तर्बहिष-
पातपूर्वकपूर्वकपादिविलक्षणगुणोपलब्धेरन्तःप्रवेशः ज्ञानोत्पत्तौ भवति तेन
विभक्तता वह्निर्द्रव्येण भेदनात् अभिघातात् वा कूनं घटादारभ्यकिमु-
च्यते तेषु क्रिया जायते क्रियाती विभागः विभागात् द्रव्यारम्भकसंयोग-
विनाशः। तद्विनाशात् द्रव्यविनाशः। पक्काय श्लाघादिगुणानवज्ञतः
रक्षादिगुणान्तरयोगमनुभवतः—चट्टप्रथमाद्याः परस्परं संयुज्य द्वाणुकादि-
प्रक्रमेण तादृशमेव घटादिकार्यमारभन्ते। एवं तत्पश्चात्तद्विनाशे
प्राप्तादिकलेषु एव एव न्यायः शरीरे अपि उदर्येण तेजसा पथ्यमानेषु
अन्नपानादिषु रसमलघातुभावेन परिणाममुपगच्छत्सु प्रायेण प्रतिक्षण-
मुत्पादविनाशौ संभवत इति। (Jayanta, Nyāyamāñjarī
भूतचैतन्य-पूर्वपक्ष). This is the Vaiseshika view, but
Jayanta himself inclines to the opposite view :—
पक्कतमुचिरतयेव कार्यद्रव्यस्य घटादिः चारम्भात् अन्तर्लोकः कथानुपवेशकत-
पाक्षोपपत्तेः अलं विनाशकल्पनया। पिटरपाकपक्ष एव पेशलः। *ibid.*
The Nyāya view :—यि बीजावयवास्ते पूर्वव्युद्भूतपरिणामेन

अङ्गान्तरमापद्यते अङ्गान्तरापत्तौ च पृथिवीधातुरव्धातुना संयुज्यते
 आन्तरैश्च तेजसा पञ्चमानो रसद्रव्यं निर्वर्त्तयति स रसः पूर्वोक्तव्यवसहितो-
 ऽङ्गु रादिभावनापद्यते । परमाण्वस्त्राणि बीजानि भवन्तीत्येतन्न प्रतिपद्यामहे ।
 यस्याच्छात्वादिबीजमुच्छ्रान्तावस्थामादि कृत्वा यावदुपान्तं शालिबीजकायं
 तावन्न कदाचित् परमाण्ववस्थं भवति । यदि तु स्नात् कदाचित् नोपलभ्येत ।
 Udyotakara, Chap. III, A'hnika 1, Sūtra 4.

11. Chemical combination (सम्भूयक्रिया, संयुक्तक्रिया).
 Chemical combination takes place either between two or more substances which are isomeric modifications of the same Bhūta, or between substances which are modes of different Bhūtas.

A. Mono-Bhautic compounds. The simplest compounds are Mono-Bhautic compounds, i. e. compounds of different substances which are isomeric modes of the same Bhūta.

(a) Mono-Bhautic compounds of the first order :—Under the impact or impulse (अभिघात or मोदन) of heat corpuscles, the substances in chemical contact (आरम्भक संयोग) break up into their atoms. These atoms are homogeneous, possessing only the original physical and chemical characters of the Bhūta concerned. As the speci-

fic differences between isomeric substances arise from the arrangement or collocation of the atoms, the substances lose their distinctive marks on decomposition into the latter.

(न च परमाणुषु अपरजातिभेदो विद्यते न च यवबीजशास्त्रबीजपरमाणूनां कश्चिद्विशेषः ।

Uddyotakara, Chap. III, A'hnika I,

Sútra 4. न च शक्रशीघ्रतपरमाणूनां कश्चिद्विशेषः

पार्थिवत्वाविशेषात् । S'ridhara, Nyāya-Kandali, पृथिवानिरूपणम्) । Under the

continued impact, (or, it may be,

impulse) of heat particles (वेगवता बहि-

द्रव्येण भोदनात् अमिघातात् वा—Jayanta),

these atoms take on new characters. It is heat and heat alone that can cause this transformation of the colours, tastes, smells, *etc.*, in these original Bhúta-atoms. What particular colours, tastes, smells or physical characters will be produced in the atoms depends (1) on the nature of the constituent substances in contact, (2) the intensity or degree of the heat (स्वर, शृद्रु or मध्यम पाक), and (3) the species of Tejas-corpuscles

the impinge on the atoms, or the nature of the impact (विलक्षणतैः-संयोगः). (न वृत्तीऽग्निसंयोगात् एकस्मात् रूपादय इति अपि तु पूर्वरूपादिविशेषापेक्षात् । यद्द्रव्यं पश्यते अग्निसंयोगेन तस्य ये पूर्वरूपादयस्तेषां यः स्वगतो विशेषस्तमपेक्षनाथः अग्निसंयोगः उत्तरान् रूपादीन् बिभ्रिटानारभते । *Vide* also Uddyotakara III, 2, Sūtra 14. Cf. also Vāchaspati, I, 1, Sūtra 4. अथाकमभिदे अपि उपादानस्य पिठरस्य औष्णापरास्यस्य च अग्निसंयोगस्य पूर्वरूपादिप्रभ्यंसानां कारणानां भेदात् भिन्नजातीया आयन गन्धरूपरसस्पर्शा इति सिद्धान्तः) ।

Now when the atoms have all been determined in the same way, they begin to recombine again under the impact (or impulse) of the heat-particles in binary molecules, (or tertiary, etc.), and these in higher aggregates. It seems to be generally held that, at the final step one or more atoms of one constituent substance unite with one or more atoms of the other constituent substance or substances to form a molecule of the com-

pound; but the question is not of much significance for Mono-Bhautic compounds of the first order, as, in these cases, the atoms have before this all lost their distinctive characters and become homogeneously transformed. The compound so produced will possess the new characters of the transformed atoms, so far as taste, colour, smell, *etc.* are concerned, but as the molecular arrangement or structure (अणु, अणुसंघटनविधान) may vary, different compound substances may result from the same components.

- (b) Mono-Bhautic compounds of higher orders :—Again, Mono-Bhautic compounds of the first order may chemically combine to form higher compounds, and as the ultimate Bhūta substratum is the same, the process of decomposition and recombination will be essentially the same as before. The only doubtful point is whether in this case the component compound substances are broken up only into their constituent molecules, or into the original homogeneous Bhūta atoms. Some of the later Vaiseshika Scho-

liasts hold that the latter happens in every case of chemical composition, however complex, but the earlier Vaiseshika conceived that in the case of compounds of compounds, the decomposition does not proceed so far as the original Bhúta atoms ; but that it is the specifically determined atoms constituting the molecules of the component compounds that are transformed under the impact of the heat-corpuscles ; and then one such transformed atom (one or more according to another version) from the molecule of one component unites with one similarly transformed atom (one or more according to the other version) from the molecule of the other component. Prasastapáda, the great Vaiseshika Doctor, holds this view. When, for example, in the fertilised ovum, the germ and the sperm substances, which, in the Vaiseshika view, are both isomeric modes of Earth (with accompaniments of other Bhútas), unite, both are broken up into homogeneous Earth-atoms, and it is these that chemically combine under the animal heat (and bio motor

Energy, वायु) to form the germ-plasm (कलल). But, next, when the germ-plasm develops, deriving its nutrition from the chyle (blood) of the mother, the animal heat breaks up the molecules of the germ-plasm into its constituent atoms (कललारम्भकपरमाणवः), i.e., into atoms specifically determined, which by their grouping formed the germ-plasm, and then these germ-plasm atoms as radicals chemically combine with the atoms of the food constituents, and thus produce cells and tissues. (समुत्पन्नपाकजैः कललारम्भकपरमाणुभिः अदृष्टवशात् उपजातक्रियैः आहारपरमाणुभिः सह सम्भूय शरीरान्तरमारभ्यते इत्येषा कल्पना । पितुः शुक्रं मातुः शोणितं तयोः सन्निपातानन्तरं जठरानलसम्बन्धात् शुक्रशोणितारम्भकेषु परमाणुषु पूर्वकृपादिविनाशे सति समानगुणान्तरौत्पत्तौ दाशुकादि-प्रक्रमेण कललशरीरौत्पत्तिः ।

...तत्र मातुराहाररसः भावया संक्रामति अदृष्टवशात् तत्र पुनर्जठरानलसम्बन्धात् कललारम्भकपरमाणुषु क्रियाविभागादिन्यायेन कललशरीरे नष्टे समुत्पन्नपाकजैः कललारम्भकपरमाणुभिः अदृष्टवशात् उपजातक्रियैः

आहारपरमाणुभिः सह सम्भूय शरीरान्तरमारभ्यते
 इत्येवा कल्पना । S'ridhara, Kandali,
 पृथिवीनिरूपणम् ।) In this hypothesis
 (कल्पना), it is assumed that the
 atoms are similarly transformed, *i.e.*,
 become endowed with the colour,
 taste, smell, *etc.* of the product (the
 cell or tissue), the moment before
 the chemical combination takes place.
 Similarly, when milk is transformed
 into curd, one view is that the trans-
 formation takes place (under internal
 heat) in the constituent atoms of
 the milk molecules, atoms specifically
 determined as milk, and not in the
 original atoms of the Bhūta (or Bhūtas)
 entering into composition of milk.
 (Cf. एवं महादुग्धारम्भैः परमाणुभिरिव दध्या-
 रभ्यते । एकमद्विषेव दध्यारम्भकैरेव पर-
 माणुभिर्नवनीतारम्भः इति दिक् । Nyāya-
 bodhinī, on Annam Bhatta's Tarka-
 saṅgraha.) Cf. Dinakarī, on the other
 hand—आणुकणपदुग्धध्वंसजनलेऽपि तस्य (दध्नः) ।
 In these cases, the atomic contact
 is called constituent contact

(चारित्र्यसंयोग), and all the atoms are equally regarded as material causes (उपादानकारण or समवायिकारण) of the compound.

- B. Hetero-Bhautic 'quasi-compounds'.—The Nyāya-Vaiśeṣika maintains that in the case of bi-Bhautic (or poly-Bhautic) compounds, which are only quasi-compounds, there is another kind of contact between the heterogeneous atoms of the different Bhūtas, which may be called dynamic contact and is distinguished in its operations as Upaśtambha, Viśtambha or Avāśtambha (उपदृष्ट, विदृष्ट or अवदृष्ट). In some cases, it so happens that the atoms of different isomeric modes of the same Bhūta do not chemically combine under the mere application of heat ;—they require to be surrounded (and 'excited', 'energised') by atoms of different Bhūtas. For example, in the case of the oils and fats as well as of plant saps and fruit juices the Earth-atoms must be dissolved in water (Ap), and it is only when the water atoms (Ap-atoms) congregate round the former that dynamic intra-atomic

forces are set up, and the Earth-atoms (with the water atoms in dynamic contact) now take on peculiar infra-sensible characters (colours, tastes, smells) under the impact of the heat corpuscles, and then, under further impact, fall into groupings or collocations (of a very peculiar nature, to be presently explained) which determine the nature of the composite substance thus produced. Here it is the water-atoms that are dynamic (उपटम्बक), and excite the Earth-atoms, and these substances, oils and fats (तैलवर्ग and घृतवर्ग), as well as acids (अम्लवर्ग) are, because of the Earth radicles regarded as Earth-compounds (or Earth-substances). (पाकज-तथाविधगन्धरसरूपादिमहिः परमाणुमिदं गुणादिकमेष घृतादिद्रव्यमारभ्यते । तत्र च उपटम्बकतया निमित्ततामापन्नाः पानीयाश्च यवाः । तेषां संयुक्तसमवायेन खेदसजीव्यमभ्यते । तैलचूरादिषु पार्थिवत्वमिति । तैलस्य भौमानलेभ्यस्तत्वात् घृतवत् । Udayana). In the above instances, Ap (water) acts as dynamic (Upash-
tambhaka, (उपटम्बक), but Tejas

and Vāyu can also act in the same way on Earth-particles. Conversely, Earth-particles may act dynamically on the atoms of the other Bhūtas. For example, in the case of mercury and the metals which are conceived in the Nyāya-Vaisesika to be igneous bodies (in fact they are supposed to be formed under the subterranean heat चाकरज), the Tejas corpuscles are believed to form the radicles, and the Earth-particles are dynamic (उपटन्मक).
 (सुवर्णादि निरन्तरं आद्यमानमपि न पूर्ववत् जहाति ।
 तेनैव द्रव्यान्तरिण प्रतिबद्धत्वात् उपटन्मकोऽपि पार्थिव-
 भागः सङ्गश्च एवानुवर्तते, यत्तु पुटपाकादिना
 रक्तसारता दृश्यते तन्निधीभूताभिभावकतत्तद्द्रव्योप-
 गमात् । एतेन पारदादि व्याख्यातम् । Udayana,
 Kiranāvalī, तैजोनिकपणम् । Cf. also योऽपि
 तेजसमिच्छति सुवर्णे तेनाप्यत्र पार्थिवी भाग उपटन्मक
 एष्टव्यः ।)

It may be here noted that Gaṅgesa, the author of the *Tattvachintāmaṇi*, conjectures that even gold can be evaporated or made to disappear by the application of intense heat ;

अथ द्रुतद्रुततरादीः क्रमशः प्रतीतेः प्रवृत्तानन्त-
संयोगेन सुवर्धनाशात् तदद्रवता नश्यति । But
Mathurānātha notes here—भक्ष्यप्राक्कालो-
च्छेदसमये । (सन्निकर्षवादरहस्य) .

But while every Bhūta can act dyna-
mically as उपदम्भक 'energiser',
'exciter', it is the Earth-Bhūta alone
which is capable of exercising the
power of arrest or inhibition of
molecular motion or the motion of
particles due to gravity as in fluids
(Vishtambha, विष्टम्भ), or the power
of counteracting the tendency in a
given set of atoms to fall into a pe-
culiar order or group (व्युद्भवविरोधित्वम्),
(न च पार्थिववत् अन्धो द्रव्यानारं गच्छद्विष्टम्भाति
पूर्वव्युद्भवं वा विरुणद्धि । Udayana, Kira-
nāvalī, पृथिवीनिरूपणम् । विष्टम्भकत्वं स्वाभा-
विकगुरुत्वाद्यद्रव्यानारगतिपतिवन्धकत्वम् । व्युद्भवविरोधित्वं
च स्वाभाविकगुरुत्ववत्पतनोतिवन्धकत्वम् । Vardha-
māna, Kiranāvalīprakāśa, *ibid.*)

Oils, fats, milks—Bi-bhautic quasi-compounds,
with Ap as energiser :—Oleaginous substances

(आज्यतैलादयः स्नेहाः) are divided by Udayana into (1) oils, derived from vegetables, (2) butters derived from milk, and (3) fats derived from animals. The medical schools, as we have seen, recognise animal oils as distinguished from vegetable oils. Vegetable fats (*e.g.* विहङ्गघृत) are also mentioned. Vāchaspati in the Tātparyyatīkā contends that mustard oil has not the flavour and smell characteristic of the true oils (sesamum, linseed *etc.*), and is classed with the latter by convention. Judged by the flavour test, A'mikshā (the casein substance formed by mixing milk-curd with hot boiled milk) is to be classed with milk substances. So also Takra, whey,—but Vājina, the thin fluid that is left after the Am'ikshā (casein substance) is separated, cannot be classed as milk. It may be added that the milks and curds as well as oils and fats derived from different species of vegetables or animals are supposed to differ in their ultimate structural arrangement and therefore in kind; but Vallabha thinks that the ghees (clarified butters) prepared from different kinds of milk are of the same kind, in other words, the milks and curds are 'polymeric', the ghees (clarified butters), 'isomeric', using these terms, as before, in a loose general sense..... तैलघृतवसानां बीजचौर-
मांसयोनितात् । अतएव नारिकेलखेंदस्तापि तैलत्वं रसादि-

साकष्यादपि तु घृतव्यपदेशश्च । Udayana, Kiranāvalī,
 पृथिवीनिरूपणम् । Vallabha notes that ghees do
 not differ in kind, as milks (and curds) do :—
 अतो माद्विषयव्यादिदुग्धेषु दधित्ववत् घृतादिषु जातिभेद-
 एवास्मानिति चेन्न ।—Vallabha, Līlāvati. Compare
 Vāchaspati, II, 2, 65 :—आज्यतैलादीनां जातिस्तु मन्वेन वा
 रसेन वा व्यज्यते । अतएव न सार्धपादौनां तैलत्वमस्ति । तदाश्लक्षयो-
 र्गन्धरसयोरभावात् । भातस्तु तैलशब्दयोगः । क्षीरजातिरपि रसव्यङ्गोऽयम् ।
 अतएवानिश्चायाः क्षीरत्वम् । न तु वाजिनस्य तदव्यञ्जकस्य रसभेदस्य
 वाजिने अभावात् आनिश्चाया अभावात् ।

III. Mixtures like soups, solutions *etc* :—A soup
 is a physical mixture of a peculiar kind, from which
 evaporation ordinarily sets the water free (cf.
 Udayana's घनपौतमुक्त infra). When meat is boiled in
 water, there is the application of heat, with chemical
 changes in the meat, but the combination of meat-parti-
 cles and water-particles in the soup is only physi-
 cal combination, and not a chemical one. It is
 of course not a true compound, neither is it a
 quasi-compound, like milk (in which the water-
 particles are 'energisers' of the Earth-particles).
 Milk, for example, retains its milky substance,
 when it coagulates or becomes solid, (this of
 course is also the case with mono-Bhautic sub-
 stances whether elementary or compound, *e. g.*
 water, which becomes ice,) but the substance
 we call a soup or solution ceases to be a soup

or solution, the moment it solidifies. Uddyotakara notices gruel, baths, and lyes (alkaline solutions) as mixtures of this class (एतेन पापकाष्ठिकविवेकावचारादयः प्रत्युक्ताः । Vārttika, Chap. I, A'hnika 1, Sūtra 14). यूपो हि नाम उत्पन्नपाकजानां द्रव्याणां कालविशेषानुवर्तते सति द्रव्यान्तरसंयुक्तानां पाकजीव्यत्वात् यः संयोगः स दूष इति । एतेन पापकाष्ठिकविवेकावचारादयः प्रत्युक्ताः । Uddyotakara, Vārttika, Chap. I. A'hnika 1, Sūtra 14. *Vide* also Vāchaspati's comment : उत्पन्नपाकजानां तैले सर्पिषि वा पिष्टमांस-पिष्टावयवानां द्रव्यान्तरेण तीक्ष्ण संयुक्तानां पाकजीव्यत्वात् सत्या न चासौ सहसा इत्युक्तं कालविशेषानुवर्तते सतीति । स च संयोगमेव एव तीक्ष्णसंयोगिनंतु अवयवो विजातीयधीरनारम्भकत्वात् । नापि दूषजातीयं तीक्ष्णसंयोगि द्रव्यं चौरजातीयमिवेति युक्तम् । तीक्ष्णविरुद्धे काठिन्येऽपि चौरबुद्धिव्यपदेश्यतीत्यादवस्थात् । इह तु काठिन्ये न दूषबुद्धिव्यपदेश्ये इति सम्बन्धमेव एव तीक्ष्णसंयोगिर्दूष इति न्यायम् । स च अनुभवसिद्धः संयोगिव्यतिरिक्तः । Vāchaspati, Tātparyyatīkā, *ibid.* For salt and alkaline solutions, *vide* Kiranāvalī—यत् पुनरम्बुधिसिन्धुभेदेन चारादिरपि रसः पाचसे उपलभ्यते स दशमूलकषायस्यैव पार्थिवद्रव्योपाधिकः । कथमन्यथा तस्यैव घनपीतमुक्तस्य रसो मधुर एव । Udayana, Kiranāvalī, जलनिरूपणम् ।

Chemical action and Heat :—The operation of heat is of course universally implied in chemical

combinations. Where the application of external heat is wanting, Vātsyāyana, the great Doctor of the Nyāya, points to the operation of internal heat. (*e.g.* पृथिवीधातुः अर्द्धधातुना संगृहीतः आन्तरिक तेजसा पच्यमानः रसद्रव्यं निर्वर्त्तयति ।—Vātsyāyana-Bhāshya, Chap. 1V, A'hnikā 1, Sūtra 47). In the case of combustion, we have seen Vijñāna-bhikshu explain the heat as latent in the Earth-substance, the fuel, from which it breaks forth. Udayana points out that the solar heat is the source of all the stores of heat required for chemical change in the world. The change of colours in grasses, for example, is due to Tejas, in the form of latent (invisible) heat, not in the form of Agni; and the cold in winter cannot take away this store derived from the Sun. (वृक्षादिविकारो हि यदि रूपादिपरावृत्तिमाचङ्कते: स नूनमौष्ण्यपेक्षेण तेजसा कर्त्तव्यः । तादृशे च पाके अनिमित्तं हिममिति । न किञ्चिदनिष्टमापद्यते । न हि सौरस्य तेजसः वेलीक्यपाकहेतोर्हिमादपगमः चमते । अथ विकारो भस्मादिरूपो विवर्त्तितः सीडसिद्ध एव हिमहेतेषु वृक्षादिषु क विरीधौ बाधो वा । अथ रूपादिपरावृत्तिमानेनैव अग्निः साध्यते तदशक्यम् । तस्य दर्शनस्यर्जनयाद्यस्य योग्यानुपलब्धबाधितत्वात् अतादृशस्य तेजोमात्रस्य निवृत्तेरशक्यत्वात् अनिष्टत्वात् च । Udayana, Kiranāvalī सृष्टिसंहारविधिनिरूपणम् ।) Similarly, it is under this solar heat that the unripe mango ripens, i.e. changes

colour, taste, smell *etc.*, showing that there is chemical transformation or subtile decomposition and recomposition going on ; and this is also the case with the rusting of the metals, which is a combustion due to the solar heat (सूर्यपाक) even as the conversion of food into chyle and of chyle into blood are instances of chemical action due to the internal animal heat (जठरानल or शीदये तेजः). But the kind of contact with heat-corpuscles, in other words, the kind of chemical action (पाक) which transforms colours is supposed to differ from that which transforms flavour (विलक्षणतेजःसंयोग) and पाक) and this last from that which produces a change of smell, or tactile quality. (पाको नाम विजातीयतेजःसंयोगः । स च नानाजातीयः । रूपजनको विजातीय-तेजःसंयोगलक्षणेन रसजनको विजातीयः । एवं स्पर्शादौ अपि तथा । एवंपकारेण भिन्नभिन्नजातीयाः पाकाः कार्यविलक्षणेन कल्पनीयाः । तथाहि त्वणुपुच्छनिचिह्नाऽद्यादौ लघ्वलक्षणविजातीयतेजःसंयोगात् पूर्व-हरितरूपनाशरूपान्तरस्य पीतादिरूपपत्तिः पूर्व्वरसस्य अस्वस्वेवागुभवात् । क्वचित् पूर्व्वहरितरूपसत्त्वेऽपि रसपरावृत्तिर्दृश्यते विजातीयतेजःसंयोग-रूपपाकवशात् पूर्व्वतनास्वरसनाशे मधुररसस्यागुभवात् । तस्माद्रूप-जनकापेक्षया रसजनको विलक्षण एवं गन्धजनको विलक्षण एवाङ्गीकार्यः रूपरसवीरपरवृत्तौ अपि पूर्व्वगन्धनाशे विजातीयपाक-वशात् सुरभिगन्धोपलब्धेः । एवं स्पर्शजनकोऽपि पाकवशात् कठिन-

स्पर्शनाग्निं स्रदुस्पर्शानुभवान् । अतएव पार्थिवपरमाणुनामिकजातीयत्वेऽपि
पाकमहिम्ना विजातीयद्रव्यान्तरानुभवः । यथा गोमुक्तवृषादीनां आपर-
माणुनां भेदे लघ्वारम्भकपरमाणुषु विजातीयतेजःसंयोगवशात् पूर्ण-
रूपादिचतुष्टयनाग्ने तदनन्तरं दुग्धे यादृशं रूपादिकं वर्तते
तादृशरूपपरसगन्धस्पर्शजनकास्तेजःसंयोगा जायन्ते । तदुत्तरं तादृशरूपादय
उत्तपयन्ते । तादृशरूपादिविशिष्टपरमाणुभिर्दुग्धशण्डकमारभ्यते । ततः
वाणकादिक्रमेण मण्डादुत्थारम्भ इति । Nyāyabodhini (on
Annam Bhatta's Tarkasangraha). Heat and light
rays are supposed to consist of indefinitely small
particles which dart forth or radiate in all directions
rectilineally with a sort of conical dispersion and
with inconceivable velocity. They may either (1)
penetrate through inter-atomic (or inter-molecular)
spaces as in cases of conduction of heat which when
applied under the pot boils the water, or fries the
paddy where there is no chemical action in the pot,
no decomposition and recombination of its atoms, no
change in the molecular collocation ; or, as with light
rays in cases of translucency or transparency
(लघ्वता) penetrate through the inter-atomic spaces
with Parispanda of the nature of deflection or
refraction (तिर्यग्गमन, Udyotakara), in the same
way as when fluids penetrate through porous bodies
(तत्र परिस्रवः तिर्यग्गमनं परिस्रवः पात इति—Udyo-

takara, commenting on Vātsyāyana's परिस्पन्द-परिस्रवौ, Sūtra 47, A'hnikā 1, Chap. III.) or (2) impinge on the atoms, and rebound back—which explains reflection (मूर्च्छन, किरणविघटन—Varāhamihira, रश्मिपरावर्तन—Vātsyāyana) or otherwise be obstructed by the atoms in their path, which would explain degrees of opacity, the casting of shadows, etc., all these operations being also physical, and unattended with decomposition and recombination or alteration of molecular grouping, or (3) lastly, strike the atoms in a peculiar way, so as to break up their grouping, transform the physico-chemical characters of the atoms, and again recombine them, all by means of continual impact with inconceivable velocity, an operation which explains all cases of chemical combination. (अचिन्त्यो हि तेजसो लाघवातिशयेन वेगातिशयः यत् प्राचीना अलक्ष्णावलम्बिनि एव भगवति मयूखमालिनि भवन्तीदरेषु आलोक-इत्यादिमानो लौकिकानाम्। (Udyana, Kiranāvalī, तेजोनिरूपणम्—taken from Vāchaspati, Tātparyyatīkā, प्रत्यक्ष-लक्षणवचम्।) Cf. also (आद्यं तेजः वेगवता सावितेन तेजसा न प्रतिव्यत्यते। Vāchaspati—वर्जिते पिण्डितमपि तेजः प्रसरत् प्रासादीदरं व्याप्नोति। तत् कस्य ह्यतोः पृथ्व्यत्वात्। स्वभावतः प्रसरदपि न स्वपरिमाणानुविधायिनं प्रत्ययमाधत्ते किं तु विषयभेदानुविधायिनम्। *ibid.* Cf. कूटिकाद्यन्तरितीपलम्बिरपि

प्रसादस्तत्तावतया कटिकादीनां तेजोमतेरप्रतिबन्धकतया प्रदोषप्रभावा-
 देशोपपन्नः। Udayana, तेजोनिर्गणम्, in reply to the
 objection—यदि हि प्राप्य गृहीयात् प्रतिघातिना कटिकद्रव्येण
 विटश्चादप्राप्तं प्रसर्पन्त्यादिकं नाददौत तश्चादप्राप्यकारि ततो न
 तेजसम्। (Udayana, *ibid.*) Definition of स्रच्छता—
 द्रव्यान्तरासम्पृक्तद्रव्यसमवायः स्रच्छता। दृष्टयाप्रतिघातः काचास-
 पटलकटिकान्तरितोपलब्धेः। स्याद्यादिषु च पाचकस्य
 तेजसोऽप्रतिघातात्। Uddyotakara, Chap. III, A'hnika
 1, Sūtra 38. चादित्वरज्जः कटिकान्तरितेऽपि दाक्षोऽवि-
 घातात्। Sūtra 47; where Uddyotakara notes—कीदृश-
 मविघातः—यस्य द्रव्यस्यावयवा न व्युत्थाने तस्य अन्तरावयवेः
 अव्युत्थमानस्य योऽभिसम्बन्धः सोऽविघात इति। Vāchaspati
 explains यस्य द्रव्यस्य भर्जनकपालादिः अवयवा न व्युत्थाने
 पूर्वोत्पन्नद्रव्यारम्भकसंयोगनाशेन द्रव्यान्तरजनकसंयोगोत्पादनं व्युद्भूतं
 तत्र क्रियते तस्य द्रव्यस्य भर्जनकपालादेरव्युत्थमानस्य
 अन्तरावयवैर्योऽभिसम्बन्धो बद्धः सोऽप्रतिघातः। Cf. Vātsyā-
 yana on Sūtra 47, A'hnika 1, Chap. III. On the
 other hand in chemical combination, अन्तःप्रवेशः
 ज्ञानोत्तरमुदीयते। तेन वेगवता वज्रिद्रव्येण मीदनात् अभि-
 घातात् वा अवयवेषु क्रिया, क्रियातो विभागः, विभागात्
 आरम्भकसंयोगविनाशः *etc.*—Jayanta, Mañjarī, मृतचैतन्य-
 पूर्वपक्षः। For opacity, shadows, *etc.*, *vide* छाया तु
 तेजःपरमाणीरावरणात् मूर्तिमता परमाणुना तेजःपरमाणु-
 राव्रियते। यत्र च अस्य आवरणं तत्र च्छायेति। विरल-
 तेजःसम्बन्धीनि द्रव्यगुणकस्यापि च्छाया इत्यभिधीयते। सर्वतो

व्याहृतैः सम्बन्धीनि तु तानि तमःसंज्ञकानि । Uddyotakara, Chap. IV, A'hnika 2, Sútra 25. For reflection, and its laws, I quote passages in my paper on Hindu Physics and Mechanics, to which the student of the history of Optics is referred.

Arrangement of atoms in Space :—The Nyáya conceives atomic magnitudes as *Párimāṇḍalya*, a term which indicates a spherical shape. (निम्नं परिमण्डलम्—परिमण्डलमेव पारिमाण्डल्यम्—*Saṅkaramisra*). To conceive position in space, *Váchaspati* takes three axes, one proceeding from the point of sunrise in the horizon to that of sunset on any particular day), (roughly speaking, from the East to the West);—a second bisecting this line at right angles on the horizontal plane, (roughly speaking, from the North to the South), and the third proceeding from the point of their section up to the meridian position of the sun on that day, (roughly speaking, up and down). The position of any point in Space, relatively to another point, may now be given by measuring distances along these three directions, *i.e.* by arranging in a numerical series the intervening points of contact, the less magnitude or distance being that which comes earlier in this series, and the greater that which comes later. The position of any single atom in Space with reference to another may be indicated in this

way with reference to the three axes. But this gives only a geometrical analysis of the conception of three-dimensioned Space, though it must be admitted in all fairness that by dint of clear thinking it anticipates in a rudimentary manner not only the foundations of solid (co-ordinate) geometry, but also of the geometry of position, and especially the conception of Space as a Manifold, which alone can serve as the basis of a generalisation comprehending all different possible kinds of geometry, Euclidean and non-Euclidean. (एकत्वेऽपि दिशः आदित्योदयदेशप्रत्यासन्नदेशसंयुक्तो

यः स इतराद्याद्विप्रकृतदेशसंयोगात् परमाणोः पूर्वः एवमादि-
त्यासन्नयदेशप्रत्यासन्नदेशसंयुक्तो यः स इतराद्याद्विप्रकृतदेश-
संयोगात् परमाणोः पश्चिमः तौ च पूर्वपश्चिमौ परमाणू
अपेक्ष्य यः सूर्योदयासन्नयदेशविप्रकृतदेशसंयोगः स मध्य-
वर्त्तः । एवमेतथोर्वी तिर्यग्देशसम्बन्धिनौ मध्यस्थ आर्जवेन
व्यवस्थितौ पार्श्ववर्त्तनौ तौ दक्षिणीतरी परमाणू । एवं
मन्थान्दिनवर्त्तिसूर्यसन्निकर्षविप्रकर्षौ अपेक्ष्य उपर्यधीभावी
द्रष्टव्यः । संयुक्तसंयोगात्स्वत्वसूयस्त्वे च सन्निकर्षविप्रकर्षौ पूर्व-
संख्यावच्छिन्नत्वं च अस्यत्वं परसंख्यावच्छिन्नत्वं च सूयस्त्वम् ।
Vāchaspati, Tātparyyatīkā, Chap. IV. A'hnikā 2,
Sūtra 25.

The original physical arrangement of atoms is also given. Each atom is in contact with six other atoms, which gives a cubical arrangement. एवं

दिशीऽपि एकस्या अपि संयोगा एव भावाः सोऽयं परमाणोः
 षट्केन युगपदयोगो मूर्तत्वमावप्रयुक्तः न सावयवत्वप्रयुक्तः । *ibid.*

Cf. also the objection in the Buddhist Kārikā.

षट्केन युगपदयोगे परमाणोः षडंशता । यथा समानदेशत्वे

पिच्छः स्वादृशभावकः ॥ This is the typical primordial

arrangement, and variations in the collocation

of atoms and molecules (अणु, अवयवसन्निवेश), as

we have seen, were conceived to account for

the variety of isomeric modes of the same Bhūta.

as well as of mono-Bhautic and poly-Bhautic compounds.

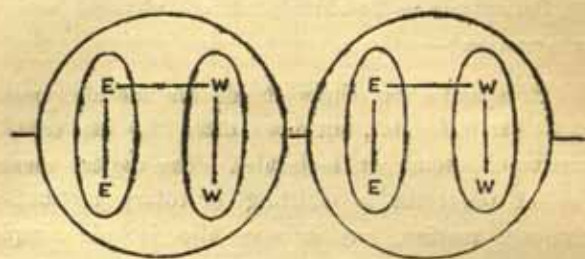
The molecular arrangement in the case of bi-Bhautic compounds is very peculiar. Two substances, say Earth and Ap (water), form a quasi-compound, first, and each substance breaks up into atoms, one atom of Earth comes into contact with one of Ap. But the two do not form a binary molecule. Instead, this contact of heterogeneous atoms leads to a curious result. The atom of Earth combines with a neighbouring atom of its own class, and forms a binary molecule. Simultaneously the atom of Ap combines with another Ap-atom, and forms a binary molecule. Now the first binary molecule links on to the atom of Ap, and similarly the second binary molecule links on to the atom of Earth. The moment after, the two binary molecules take on the physico-

chemical characters of Earth and Ap respectively, and simultaneously with the assumption of these physico-chemical characters, the binary molecules enter into complex contact (संयोगज संयोग). In all this process, work is done only in the first instant, in the contact of an atom of Earth with one of Ap—the resulting contacts, of atom with binary molecule and of the binary molecules with each other, involve no further expenditure of Energy. Thus we get a particle holding two binary molecules (of Earth and Ap respectively) in complex contact, and such particles continue to be formed. In this way the particles of the two substances arrange themselves, and the peculiarity of this molecular arrangement explains the resulting mixed or compound qualities of this class of quasi-compounds. (संयोगजस्तु संयोगः) उत्पन्नमात्रस्य

विरोधप्रसक्तं वा निष्क्रियस्य कारणसंयोगिकारणः कारणा-
कारणसंयोगपूर्वकः कार्याकार्यगतः संयोगः ।.....एक-
स्याश्च इयोरुत्पत्तिः कथम् । यदा पार्थिवान्धवीरस्त्रीः संयोगे
सति अन्येन पार्थिवेन पार्थिवस्य अन्येन आग्नेन च
आग्नेस्य युगपत्संयोगो भवतस्तदा ताभ्यां संयोगाभ्यां पार्थि-
वाग्ने इत्युक्तं युगपदारभ्येति । ततो यस्मिन् काले इत्युक्तयोः
कारणगुणपूर्वकमेव रूपाद्युत्पत्तिः तस्मिन्नेव काले इतरतर-
कारणाकारणमतात् संयोगात् इतरतरकार्याकार्यमती संयोगौ युगप-
दुत्पद्येते । किं कारणम् । कारणसंयोगिना हि अकारणेन कार्ये
अवश्यं संयुज्यते इति न्यायः । अतः पार्थिवं इत्युक्तं कारणसंयोगिना

आद्येन अणुना सम्बध्यते । आद्यमपि द्वाणकं कारणसंयोगिना पार्श्वेति
(Praastapáda-Bhāshya, मुखरन्त्रे संयोगनिरूपणम् ।)

The whole process may be graphically represented as follows :—



E = an atom of Earth.

W = an atom of water (Ap).

E
|
E = a binary molecule
of Earth.

W
|
W = a binary molecule
of water (Ap).

Molecules of a bi-
Bhautic quasi-com-
pound;—graphic for-
mula of complex
contact.

I will conclude this account of ancient (and mediæval) Hindu chemistry with a note on the conception of molecular (atomic) motion, Parispanda, and the different varieties of such motion which were conceived to account for the physical phenomena of sound, light and heat. Any attempt to differentiate rigidly between Mechanics and

Physics on the one hand and Chemistry on the other at this primitive stage would be an idle affectation. My paper on Hindu Mechanics and Physics will give a detailed exposition in a separate treatise.

Parispanda :—Resolution of all physical action into motion :—

Parispanda sometimes stands for motion molar as well as molecular, but more often for the subtle motion of atoms or molecules. The radical meaning of the term is whirling or rotary motion, a circling motion, but it may also include simple harmonic motion (*e. g.* vibration). All action, operation, work (क्रिया व्यापार) is ultimately traced to this form of subtle motion lodged in the atoms or in the matter-stuff. The Vedānta, for example, speaks of a cosmic vibratory motion (सर्व्वलोक-परिरपन्दनम्—Saṅkara).—A'kāśa, in the Vedānta, as we have seen, is the first stadium in the evolution of Matter, which gives off Vāyu, which gives off Tejas, and so on ; but A'kāśa (Ether) itself passes through two stages before the emanation of the Sūkshmathūta Vāyu :—(1) the motionless ubiquitous primordial matter-stuff (answering to the Sāṅkhya Bhūtādi) called Purāṇam kham (पुराण खं) and (2) a subtle integration, the pure unquintuplicated Sūkshmathūta called Vāyuram Kham

(वायुरं खं) (answering to the Sāṅkhya Tanmātra stage). It is this subtle Ākāśa, in its Tanmātric integration, i. e. in the derivative form, which is subject to an incessant Parispanda. The gaseous stage of matter (the Vedāntic Vāyu) is indeed matter in a state of Parispandic motion (वायोः परिस्पन्दात्मकत्वात्—Sankara). So also the bio-motor and sensori-motor principles apart from the directive Intelligence of the Self (प्राणश्च परिस्पन्दात्मकत्वादिषु—यद्वैतम् सूत्रं सूत्रञ्च तत्सर्व्वे मनःस्पन्दितमावन्—Sankara). The Sāṅkhya also conceives this Parispanda to characterise every process and phenomenon of cosmic evolution (व्यक्तं सक्रियं परिस्पन्दवत्—Vāchaspati, Kaumudī). Bhūtas, organisms, mental organs, as modes of Prakṛiti (considered apart from the Intelligence of Puruṣa) are all subject to this Parispanda बुद्ध्यादयो दीप्त व्यजने दीप्तान्तरं उपाददन्ते इति तेषां परिस्पन्दः । शरीरपञ्चव्यादोनां च परिस्पन्दः प्रसिद्ध एव ।—Vāchaspati on Kārikā 10). On the other hand, Prakṛiti as the Avyakta, the a-cosmic, the un-manifest ground, with resolution only of like to like (सहस्रपरिणाम), is devoid of all Parispandic motion (यद्यपि अव्यक्तास्त्वापि परिणामलक्षणा क्रिया, तथापि परिस्पन्दो नास्ति । *ibid.* on Kārikā 10). The Nyāya-Vaiśeṣhika finds Parispanda in all

forms of matter, except A'kāśa which, in that system, is non-atomic and incapable of any change or activity (निष्क्रिय). But all atoms from those of Vāyu downwards, are in incessant motion. The world at bottom is an infinitude of continually whirling (or vibratory) particles (अनवरतपरिस्पन्दमानापरिमितपवनादिपरमाणवः—Raghunātha;—compare also Udayana-Kusumāñjali, Stavaka V.—परमाणवः हि गतिशीलत्वात् पतव्यवपदेशाः पतन्तीति।). All physical action consists in motion. The Nyāya-Vaiśeṣhika rejects force, power, operation (शक्ति) except as modes of motion. Jayanta indeed states: we do not acknowledge any mysterious power or operation, which the senses do not and cannot report to us. But this denial of Force (शक्ति) and of unperceived and unperceivable operation (अतोन्द्रियव्यापार) is put forward as a philosophical (epistemological and metaphysical) proposition to justify the Nyāya analysis of the causal *nexus* into mere invariable and unconditional antecedence among phenomena without productive power or efficiency (अन्यथासिद्धियुक्तस्य नियतपूर्ववर्तिता—Bhāṣhā-Parichchheda). It is not of course intended to question the existence of Parispanda, which is of the nature of motion, and which, though subtile and therefore infra-sensible (सूक्ष्म and अनुद्गृतव्य, not अतोन्द्रिय), is the ultimate form of all physical

activity. (परिस्रन्द एव भौतिकी व्यापारः करीतव्यः । अतीन्द्रियस्तु व्यापारः नास्तीति द्रुमहे ।.....तस्मात् कारक-चक्रेश चलता जन्वते फलम् । न पुनश्चलनादस्ती व्यापार-उपलभ्यते । Jayanta, Nyāya-Mañjarī, Ahnika I). The effect (no less than the action) is, in all cases of material causation, the resultant of the combined motions of the various (material and efficient) causes involved (e. g. in the case of पाक-समुदित-देहदृष्टादिसकलकारकनिकरपरिस्रन्द एव विशिष्टफलावच्छिन्नः पाक इत्युच्यते । ... अथ व्यापार एवेवः सर्वः संभूय साध्यते । किं फलेनापराजं नः तद्धि संभूय साध्यमान् ।—Jayanta, Nyāya-mañjarī, A'hnika I).

But, in the Nyāya-Vaisheshika, though all action of matter on matter is thus resolved into motion, conscious activity is sharply distinguished from all forms of motion, as against the Sāṅkhya-Vedānta, which, as we have seen, considered every thing other than Intelligence, the Purusha or the transcendental Self, to arise in the course of cosmic Evolution, and therefore to be subject to Parispan-dic motion. (क्रियाविशेष इवायं व्यापारी ज्ञातुराकारः । स्रन्दामकवह्निर्भूतक्रियालक्षणाविलक्षणः ।—Quoted in Jayanta's Nyāya-mañjarī, A'hnika IV).

Santāna, i. e. Gati-santāna (including wave motion and current motion or convection) : Kampa santāna, Spandana, (vibration) :—Charaka notes

three kinds of *santānas*, serial motions, *vis.*, those of water, sound and light (अक्षसन्तान, शब्दसन्तान and चक्षुःसन्तान). Chakrapāṇi points out that a wave of sound travels more rapidly than a wave of water, and much less rapidly than a ray of light. In Hindu Mechanics, a current of water (downward flow, स्रवण) is conceived to consist of particles moving in an uninterrupted series under the action of gravity and fluidity (गुरुत्व and द्रवत्व). A ray of light implies the rectilinear propagation of indefinitely minute corpuscles, in all directions, with inconceivable velocity, and a sort of conical dispersion (चक्षुष्यो हि वेगातिशयः तेजःप्रसरणं व्याप्नोति पृथ्वदलात् Uddyotakara—Vāchaspati). A wave of water (वीचि-तरङ्ग) implies the transmission of vibratory motion in the water particles. (Cf. Jayanta—पतद्दधनपद्मोविन्दु-संदोहस्रवन्दनकलात्, A'hnikā II). A wave of sound is conceived by some on the analogy of a wave of water (वीचितरङ्गन्याय), only the air-waves (cf. the Mīmāṃsā) or the sound-waves in and through the vehicle of air waves (cf. the Nyāya-Vaisesika) travel by concentric circles not in one but in all planes. (N. B. this assumes transverse waves). Others hold that the air waves (cf. the Vākya-padiya) or the sound and air waves (cf. Uddyotakara) are propagated by the transmission of the vibration in all directions, leading to conjunction and disjunction of air-particles, so that the wave may be said to expand by alternate concentric

spherical layers of rarefaction and condensation (प्रचय) (N. B. this assumes longitudinal waves),—
 (कन्दम्बगीलकन्दाय—cf. संयोगविभागा नैरन्तर्येण क्रियमाणाः
 शब्दमभिव्यञ्जन्तो नादशब्दवाचाः (Savara-Bhāshya 1—1—17)
 अभिघातेन हि प्रेरिता वायवः क्षिप्तानि वायुनराशि प्रति
 धावमानाः सर्व्वतोदिकान् संयोगविभागान् उत्पादयन्ति ।—*ibid.*
 1—1—13). The Vākya-padīya describes articulate
 sounds (Varnas) and indeed all sounds (śabdas) as
 only forms of air set in motion, with rarefaction and
 condensation (प्रचय), and capable of variations
 of velocity and configuration (स्थानेष्वभिहितो वायुः शब्दत्वं
 प्रतिपद्यते । तस्य कारणसामर्थ्यात् वेगप्रचयधर्म्मिणः । संनिपातात्
 विभज्यन्ते सारवत्योऽपि मूर्त्तयः—Vākya-padīya, Kānda
 I. Sloka 109) (*vide* my paper on Hindu Mechanics
 and Physics). (For the Hindu doctrine of scientific
 Method, *vide* Appendix; for certain interesting
 recipes of chemical technology, *vide* Addenda).

I had intended to conclude this survey of Hindu
 Physico-chemical science with a comparative esti-
 mate of the evolution of scientific ideas in the cul-
 ture-history (kultur-geschichte) of the Chinese, the
 Greeks and the Arabs, as an Essay in the historico-
 comparative method of investigation (*vide* the Intro-
 duction to my Comparative studies in Vaishnavism
 and Christianity for a correction of this method),
 but space forbids, and the reader too, I fancy.

The Date of Basaratnasamuchchaya.

While the present volume was about to issue from the press, Mr. T. G. Kāla, Editor of the Marhattā Journal "Samālochaka", sent us a critical notice of R. R. S. As there are some important historical facts brought to light and as the date of this work arrived at from quite independent sources tallies with that assigned by us (Vol. I. Intro. LXXXIX), we make no apology for reproducing its substance in a condensed form.

Charpatī or Charpatinātha of the Nātha school is mentioned in the R. R. S., (see VI, 58, Poona edition), as also king Singhana.

The Navanātha Śaktisāra, a Marhattā work by Narahari Māla, gives some legendary information about this Charpatinātha and speaks of him as a contemporary of Matsyendranātha. On the left has

मत्स्येन्द्रनाथ
—
गोरक्षनाथ
—
मेनोनाथ
—
निङ्गलिनाथ
—
ज्ञानदेव

} been given the geneology of the pupils of मत्स्येन्द्रनाथ. The last, ज्ञानदेव or ज्ञानेश्वर, was the celebrated Marhattā Saint and author of a commentary on the भगवद्गीता called ज्ञानेश्वरी.* It was written in Saka 1212,

i.e., A. D. 1290. So मत्स्येन्द्र and Charpatinātha must have lived at the *beginning of the thirteenth century A. D.*

*See the concluding portion of ज्ञानेश्वरी, a Marhattā work.

The R. R. S. which mentions the Siddha Char-pati must be therefore later than the first half of the thirteenth century A. D.

सिद्धचन्द्र II (A.D. 1069)

सिद्धचण्ड I

महम्मद

भित्तन (A. D. 1191)

कैमपाल (A. D. 1191-210)

सिद्धचण्ड II (A.D. 1210-1247)

Among the Yádava kings of Devagiri or Daulatábád, there were two kings by the name of Singhana. Taking the Singhana mentioned by R. R. S. to be the second, we are required to place the composition of the

work in the latter half of the 13th century. On the whole the R. R. S. may be safely taken to be a work written *about 1300 A. D.*

THE WEIGHT OF AIR.

(*By Principal B. N. Seal*).

Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, *e.g.*, metallurgy, dyeing, pharmacy, perfumery, cosmetics, horticulture, and themaking of glass (lenses and mirrors of various kinds are mentioned, the spherical, oval—*वृत्त* and *वर्तुल*, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). But of Experiment as an independent method of proof or discovery, the instances are rare, I may

note one interesting example in Udayana's Kiranāvali, relating to the weight of air. Udayana argues that air must be a distinct and independent Bhūta, for if air were made of the Earth-Bhūta, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says by one who accepts the weight of air—that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, धूम) rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (gas, धूम) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes, at least as applied to gases. Vallabhāchārya in the Lilāvati speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float or to come up to the surface of the water but the description shows that he had no clear ideas on the subject. Cf. Udayana, Kiranāvali, बायुनिश्चयम् । Cf. also Vallabhāchārya, Lilāvati.

APPENDIX.

On the Scientific Method of the Hindus.

(BY PRINCIPAL BRAJENDRANATH SEAL.)

The Doctrine of Scientific Method :—A study of the Hindu Methodology of Science is absolutely essential to a right understanding of Hindu positive Science, its strength and its weakness, its range and its limitations. Apart from this rigorous Scientific Method, Hindu Chemistry, such as it is, would be all practical recipe, or all unverified speculation. This, however, would be a very inadequate and indeed erroneous view of this early achievement of the human mind. That the whole movement was genuinely and *positively* scientific, though arrested at an early stage, will appear from the following brief synopsis of the Hindu Methodology of Science.

Criterion or Test of Truth (after the Buddhists) :—The ultimate Criterion of Truth is found not in mere cognitive presentation, but in the correspondence between the cognitive and the practical activity of the self, which together are supposed to form the circuit of consciousness. That knowledge is valid which prompts an activity ending in fruition. Cf. the distinction between *सम्वादिज्ञान* and *विसम्वादिज्ञान* । Also compare, *प्रमाणतोऽर्थप्रतिपत्तौ प्रवृत्तिसामर्थ्यात् अर्थवत् प्रमाणम्*—

Vātsyāyana). Truth, the Buddhists contend, is *not* self-evidence, *not* the agreement between ideas, *nor* the agreement of the idea with the reality beyond if any, for this cannot be attained direct, but the harmony of experience (सम्बन्ध), which is implied when the volitional reaction, that is prompted by a cognition and that completes the circuit of consciousness, meets with fruition, *i. e.*, realises its immediate end (cf. Śrīharsha, Khandana Khanda Khādyā on the relation of प्रमा to लोकाव्यवहार). This is the material aspect of Truth. The formal aspect is given in a principle which governs all presentations in consciousness, and which combines the three moments of Identity, non-Contradiction and Excluded Middle in every individual cognitive operation [तदुक्तं तत् परिच्छिन्नमिति (identity) अन्यद् व्यभिचिनमिति (non-contradiction) तृतीय-प्रकाराभावं च सूचयति (excluded middle) इति एकप्रमाण-व्यापारः—Jayanta, Nyāya-Manjarī, प्रमाणद्वैविध्यखण्डनम्]

Perception :—The conditions of perception, and its range and limits, were carefully studied. The minima sensible (*e.g.*, the minimum visible, the Trasarenu, the just perceptible mote in the slanting sunbeam), the infra-sensible (अनुद्रुतदृश्य सूक्ष्म, sometimes termed अतीन्द्रिय the obscured (अभिभूत, *e.g.*, a meteor in the mid-day blaze), and the potential (अनुद्रुतशक्ति), are distinguished; but finer instruments of measurement were wanting, and this was a principal cause of arrested progress. It may be noted that the measurement of the relative pitch of

musical tones was remarkably accurate and original (*vide* my Paper on Hindu Mechanics and Physics).

Observation (दर्शन—Vāchaspati and Udayana) :—

The entire apparatus of scientific method proceeded on the basis of observed instances carefully analysed and sifted. This was the source of the physico-chemical theories and classifications, but in Anatomy, the Hindus went one step further; they practised dissection on dead bodies for purposes of demonstration. Ingenious directions are given, *e.g.*, the body must be first disembowelled and wrapped round with the kusa and other grasses, then kept immersed in still water for seven days, after which the medical student should proceed to remove the layers of the skin with a carefully prepared brush made of the fresh elastic fibres of green bamboos;—which will enable the tissues, vessels and ducts to be observed. *Post-mortem* operations as well as major operations in obstetric surgery (the extraction of the foetus, etc.) were availed of for embryological observations (*e.g.*, it is stated as a result of observation that the rudiments of the head and the limbs begin to appear in the foetus in the third month, and are developed in the fourth; the bones, ligaments, nails, hair, etc. becoming distinct in the sixth);—and also embryological theories, *e.g.*, the indication of sexual character in the second month by the shape of the foetus, the shape of a round joint indicating the male sex, and an

elongated shape as of a muscle the female sex (cf. Charaka, Sûtrasthāna, Chap. IV,— द्वितीये मासि घनः सम्पद्यते पिण्डो देश्यर्जुदं वा । तत्र घनः पिण्डः पुरुषः स्त्री देशी अर्जुदं नपुंसकम् । Chakrapāni notes : घनः कठिनः । पिण्डो रज्याकारः । देशी दीघमांसपेक्षाकारः । अर्जुदं वर्जुलौघतम् loc. cit.) In Phonetics (as in the Prātisākyas, circa 600 B. C.), in Descriptive and Analytical Grammar (as in Pānini), and in some important respects in Comparative Grammar (as in Chanda's and Hemachandra's Grammars of the Prākṛita Dialects), the observation was precise, minute and thoroughly scientific. This was also the case in Materia Medica, and in Therapeutics, especially the symptomology of diseases. In Meteorology, the Hindus used the rain-guage in their weather forecasts for the year, made careful observations of the different kinds of clouds and other atmospheric phenomena (e. g., they give the heights of the clouds, the distance from which lightning is ordinarily visible, or the thunder is heard, the area of disturbance of different earth-quakes, the height to which the terrestrial atmosphere extends, etc., vide Varāhamihira, Śrīpati, and the authorities quoted by Utpala). In Astronomy, the observation was, generally speaking, very defective as in the determination of the solar and the planetary elements, and this was probably due to the lack of practical interest, but the determination of the lunar constants entering into the calculation of lunar periods and eclipses, matters in

which the Hindus had a practical ceremonial interest, reached a remarkable degree of approximation (much above Græco-Arab computations) to the figures in Laplace's Tables, which can only be explained by the circumstance that in the case of these constants the Hindus carried out for more than a thousand years a systematic process of verification and correction by comparison of the computed with the observed results (like the navigator's correction of the course of the ship at sea), a process which was termed *दृग्गच्छितैश्च*. In Zoology, the enumeration of the species of Vermes, Insecta, Reptilia, Batrachia, Aves, etc., makes a fair beginning, but the classification proceeds on external characters and habits of life, and not on an anatomical basis. In Botany, the observation was mainly in the interests of *Materia Medica*, and the classification was as superficial as possible. (*Vide* my paper on the Hindu Classification of Plants and Animals).

Experiments :—Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, *e. g.*, Metallurgy, Pharmacy, Dyeing, Perfumery and Cosmetics, Horticulture, the making and polishing of glass (lenses and mirrors of various kinds are mentioned, the spherical and oval *वृत्त* and *वर्तुल*, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). And the

results of such experiments were freely drawn upon for building up scientific hypotheses and generalisations. But of experiment as an *independent* method of proof or discovery, the instances recorded in books are rare. I may note one interesting example in Udayana's *Kiranāvali*, relating to the weight of air. Udayana argues that air must be a distinct and independent *Bhuta*, for if air were a form of the Earth-*Bhuta*, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says, by one who accepts the weight of air—that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, *धूम*), rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (or gas, *धूम*) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes. Vallabhāchāryya in the *Līlāvati*, it is true, speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float

or to come up to the surface of the water, but the description shows that he had no clear ideas on the subject.

Mathuránátha, again, states that the determination of the degree of purity (the carat) of gold by rubbing against the assaying stone and observing the character of the yellowish streak against the black smooth background, is only an indirect means of ascertaining weight (गुरुत्वनिर्णयः lit. specific gravity) —which seems to suggest that there was a more direct means of arriving at the latter. Probably this refers to the common Indian method of comparing the lengths and weights of wires of uniform thickness that can be formed by drawing different pieces of gold through the same diamond bore. I think it may be regarded as fairly certain that the Hindus were ignorant of Archimedes's discovery, an ignorance which, at any rate, they could not have well borrowed from the Greeks, no more than they could have thus borrowed their knowledge of things unknown to the Greeks themselves. [Cf. Udayana, Kiranāvali :—

वायुनिरूपयन्, किं च (वायोः) पृथिवीत्वे गुरुत्वमपि स्यात् । न च पवनापूरितस्य चर्मपुटकादिः अपूरणदशातः अधिकं अवनमनम् । उन्नीयमानस्य धूमापूरितेन दृढम् अनैकान्तिकं इति चेत् । न । अलं धूमदशायाः । तथापि गरिमविशेषहेतोरवनतिविशेषस्य अप्रतीतिः ।—cf. Vallabhāchāryya, *Līlāvatī*—गुरुत्वविशेषेऽपि पादाद्यालानुप्रवृत्तिषु भव्यनो-
न्मथन नियमवत् अदृष्टहेतुकता साम्येऽपि पतनोत्पतन-नियमो भविष्यतीति ।

चेत् न । जलाधोगमनं जलेन धारय पतनप्रतिबन्ध उन्मज्जनं एतच्च जलस्य योगस्य कस्याचिदेव पतनप्रतिबन्धसामर्थ्यात् । दृष्टहेतुकमेव मज्जनञ्च उन्मज्जनञ्च]—cf. Mathuránátha, सन्निकर्षवादरहस्य on Gangesa's Tattvachintāmani—तस्य (निकर्षोपलस्य) न सुदर्श-पोताभिव्यञ्जकत्वं किन्तु पीतद्वारा गुरुत्ववैलक्षण्यव्यञ्जकत्वमेव तस्य ।

Fallacies of Observation—Mal-observation and Non-observation :—These were carefully studied in relation to errors of observation, and Hallucination (भ्रम, चञ्छास, आरीष)—which were ascribed to three causes :—(a) Dosha, दोष, defect of sense organ, as of the eye in jaundice, or of the skin in certain forms of leprosy (leading to tactile insensibility, cf. Susruta) or defect of necessary stimulus, *e.g.*, too faint light, or undue distance or nearness, in vision ; (b) Samprayoga, समप्रयोग, presentation of a part or an aspect instead of the whole ; and (c) Sanskāra, संस्कार, the disturbing influence of mental predisposition, *e.g.*, expectation, memory, habit, prejudice, etc.

The Doctrine of Inference :—Anumāna (Inference) is the process of ascertaining, not by perception or direct observation, but through the instrumentality or medium of a mark, that a thing possesses a certain character. Inference is therefore based on the establishment of an invariable concomitance (Vyāpti, व्याप्ति) between the mark, and the character inferred. The Hindu Inference (Anumāna) is therefore neither merely formal nor merely material, but a combined Formal-Material

Deductive-Inductive Process. It is neither the Aristotelian Syllogism (Formal-Deductive Process), nor Mill's Induction (Material-Inductive Process), but the real inference which must combine formal validity with material truth, inductive generalisation with deductive particularisation.

An inference admits of a rigorous formal statement,—in the shape of five propositions, for dialectical purposes (*i.e.*, in demonstrating to others), or of three propositions when the inference is for one-self (साक्षात्मान):—(1) the probandum, the statement of the proposition to be established (प्रतिज्ञा, साध्यनिर्देश, *e.g.*, yonder mountain is fiery (say, an active volcano); (2) the reason, the ascription of the mark (हेतु, निश्चयपदेश),—*e.g.*, for it smokes; (3) now, the general proposition, stating the invariable concomitance which is the ground of the inference,—clenched by an example bringing home the responsibility of the reasoner to establish a real relation, *e.g.*, whatever smokes is fiery, as an oven; (उदाहरण);—(4) next, the application, the ascertainment of the existence of the mark in the present case (उपनय) *e.g.*, yonder mountain smokes;—(5) finally, the conclusion, the probandum proved (निगमन), *e.g.*, yonder mountain is fiery.

1. Yonder mountain is fiery.
2. For it smokes.
3. Whatever smokes is fiery, as an oven.

4. Yonder mountain does smoke.

5. Therefore, yonder mountain is fiery.

For inference for oneself, only the first three or the last three propositions, are held to be sufficient.

The Hindu Anumāna, it will be seen, anticipates J. S. Mill's analysis of the syllogism as a material inference, but is more comprehensive;—for the Hindu Udāharana, the third or general proposition with an example, combines and harmonises Mill's view of the major premise as a brief memorandum of like instances already observed, fortified by a recommendation to extend its application to unobserved cases, with the Aristotelian view of it as a universal proposition which is the formal ground of the inference. This Formal-Material Deductive-Inductive process thus turns on one thing—the establishment of the invariable concomitance (अनिवार्यसम्बन्ध) between the mark and the character inferred,—in other words, an inductive generalisation. The question is—what is our warrant for taking the leap from the observed to unobserved cases? Under what conditions are we justified to assert a Universal Real Proposition on the basis of our necessarily limited observation?

The Chārvāka view :—Among the Chārvākas there were two classes, the cruder school of materialists who accepted perception (प्रत्यक्ष) as a valid source of knowledge, as well as the reality of

Natural Law (स्वभाव), and the finer school of sceptics, who impugned all kinds of knowledge, immediate as well as mediate, and all evidence, Preception as well as Inference, *vide* Jayanta's reference in the Nyāya-Manjarī to सुशिक्षितचार्वकाः; also चार्वकधर्मेषु अद्यावत्तत्त्वं व्याख्यास्याम इति प्रतिज्ञाय प्रमाणप्रतिद्वन्द्वस्यालक्ष्य-नियमाश्रयकरणीयत्वमेव व्याख्यातवान्—A'hnika I, Manjarī.

The Chārvākas hold that the principle of causality, which the Buddhists assume to be a ground of an induction (आदि) is itself an induction (a case of Vyāpti), which amount to reasoning in a circle (चक्रक); that every inference is based on an unconditional invariable concomitance which itself must be inferred, as universal propositions cannot be established by our limited preceptions, and thus there is a regressus ad infinitum (अनादि परम्परा); and that the nexus between cause and effect, or between the sign and the thing signified (*e.g.*, smoke and fire) is only a mental step or subjective association based on former perception, a mental step which by accident is found justified by the result in a number of cases.

The Buddhists—their Analysis and Vindication of Inference :—The Buddhists, however, take their stand on the principle of the Uniformity of Nature (प्रतिबन्ध, स्वभाव प्रतिबन्ध, Nyaya-Vindu). This uniformity, for scientific purposes, has to be divided into two different relations,—(1) the uniformity of succession in the relation of cause and effect, *e.g.*,

of smoke to fire (कार्यकारणभाव, तदुत्पत्ति, Nyaya-Vindu); (2) the uniformity of co-existence (in the form of co-inherence in the same substrate) in the relation of genus and species, *e.g.*, the relation of invariable concomitance expressed in the proposition,—all Sinsapās are trees,—which is not a relation of causality, but of co-existence or co-inherence in the same substrate (*i.e.*, the co-inherence of the generic qualities of a tree with the specific characters of a Sisu tree, in this particular individual before me, a Sisu tree),—a relation which may be termed essential identity (तदात्म्य, सत्ताव—Nyaya-Vindu). To these two, the Buddhists add a third ground of inference, non-perception of the perceptible (अनुपपन्नं हि दृश्यानुपपन्नं हि), which is employed in inferring the absence (प्रतिषेध) of a thing from the non-perception of something else. In all cases of inference based on the Uniformity of Nature, the relation is that of inseparableness or non-disjunction between the mark and the character inferred. The question is—how is this inseparableness (अविनाभाव) ascertained, and what is the warrant of our belief in it, in these cases?

Ascertainment of Inseparableness or Non-disjunction : Buddhist Account :—First take the case of causation. The cause is the invariable antecedent of the effect. What is meant is that the specific effect (with all the distinctive and relevant accompaniments, कार्यविशेष) is invariably preceded by a

specific cause (कारणविशेष). It is not that clouds always lead to rain, or that floods in the river valley always imply rain in the hills higher up. But this particular conjunction of antecedent circumstances (*e.g.* the appearance of a particular kind of clouds accompanied with flashes of lightning, the roll of thunder and flights of Valákás—driven by the wind from a particular quarter of the horizon, and ascending in black masses, etc.) is as a rule the precursor of a particular assemblage of rain effects (rain with particular accompaniments). Again, this particular kind of flood (overflowing of the river banks accompanied with muddy discoloration of the water, rapid currents, the bearing down of tree trunks, etc.) is always preceded by rain in the hills higher up (though, no doubt, other case of floods in a river may be due to a breach in an embankment or the melting of the snows). In other words, the Buddhists (and the earlier Nyāya Schools) avoid the difficulty arising from the plurality of causes by taking into consideration the accompanying phenomena, which, if properly marked, would always point to a specific cause of a specific effect.

I quote Nyāya authorities, but this device to obviate the plurality of causes is common to the early Nyāya and the Buddhistic systems.

पूर्ववत् । यच्च कारणेन कार्यमनुमीयते । उदाहरणम्—

मेघोन्नत्या भविष्यति वृष्टिरिति कारणेन कार्यानुमानम् । अथ

पुनरस्य प्रयोगः । इष्टिमन्तः एते मेघाः सन्धीरध्वनिवत्त्वे सति बहुवल्गाका-
वत्त्वे सति अचिरप्रभावत्वे सति उन्नतिमत्त्वात् इष्टिमन्मेघवत् ।

शेषवत् (यत्र कार्येण कारणमनुमीयते)—उदाहरणम्—

उपरिर्इष्टमद्देशसम्बन्धिनी नदीसीतः शीघ्रत्वे सति पूर्णफलकाष्ठादि-
बहनवत्त्वे सति पूर्णत्वात् पूर्णइष्टिमन्नदीवदिति । (Uddyotakāra,
Chap I. A'hnika 1, Sūtra 5). Vāchaspati puts this
clearly :—यद्यपि कारणमात्रे व्यभिचरति कार्योत्पादं तथापि यादृशं
न व्यभिचरति तत्र निपुणेन प्रतिपद्या भवितव्यम् । अन्यथा धूमनामपि दग्धि-
मत्ता व्यभिचरतीति न धूमविशेषो गमकी भवेत् । In other words,
a single condition called a cause is not invariably
succeeded by the effect, nor does the effect
phenomenon in general point to any particular
cause as antecedent, for there may be a plurality of
causes of a general effect. The skilful observer
will therefore select the full complement of
causal conditions, which is invariably succeeded by
the effect,—and also the specific effect (e.g., धूमविशेष)
which points to a specific causal antecedent.
Compare also Jayanta :—we infer an effect from a
specific assemblage of causes—न च कारणमात्रस्य हेतुत्वं इमी-
येनास्य व्यभिचारः स्यात् । अपि च विशिष्टमेव कारणं हेतुः । न च
कारणविशेषो दुरवगमः । सन्धीरगर्जितारध्वनिभिर्गगनगिरिगङ्गराः शीतल-
गवलयलतमालमलिनस्त्रिषः...इष्टं व्यभिचरन्तीह नैव प्रायः पयोमुखः ।
अनभ्युपगमे चैवमनुमानस्य जीवितम् । न स्याद्धूमविशेषाणामपि बोधुन-
शक्तिरिति । Similarly we infer a specific cause from
a specific assemblage of effects :—शेषवदिति यत्र कार्येण

कारणमनुमीयते यथा नदीपुरीष उपरितने दिग्ने द्वाष्टरिति । इष्टिमत-
पृष्ठदीर्घसंख्यता इयं नदी फेनिलकलुषत्वादिविशिष्टपुरीषेतत्वात् । यत्
सेतुमङ्गलमविलयनादिनापि नदीपुरीषपत्तिर्दृष्टा इति तत्रापि 'उच्यते—

प्रमातुरपराधीऽयं विशिषं यो न पश्यति ।

नानुमानस्य दीर्घोऽस्ति प्रमेयाव्यभिचारिणः ॥

(Nyāya-Manjarī, A'hnika 2, on Gotama Sūtra
5, A'hnika 1, Chap I.)

A specific assemblage of causes, therefore, has only one specific assemblage of effects, and *vice versa*. Of course, the observer is to find out the essential or relevant features (as distinguished from the irrelevant ones) which, being included, will enable him to specify the particular cause of the particular effect.

Now this being premised to be the exact meaning of the inseparableness or non-disjunction in the case of cause and effect, we come to the question with which we started—how is this relation to be ascertained or established between two phenomena or assemblages of phenomena ? Obviously, mere observhction of their agreement in presence (*अन्वय*) and their agreement in absence (*व्यतिरेक*) is no help in the matter. Take a concrete example. The ass is customarily employed to bring the fuel with which fire is lighted. In a hundred cases you have observed the ass among the antecedents of smoke. In a hundred cases you may have observed that when there is no ass, there is no smoke. This is no

warrant for concluding a relation of cause and effect between an ass and smoke. It may be that you happen to have never observed smoke without an antecedent ass, or an ass without smoke following. Even this is of no avail. It is not agreement (unbroken and uniform though it be) in presence, or in absence, or in both, that can settle the matter. There is one and only one way of ascertaining the causal relation. Suppose *A* with certain accompaniments is found to precede *B* immediately. Now if *A* disappearing, *B* disappears, even though all other antecedents remain and there is no other change in the case, then and then only can the causal relation be ascertained. It is not a mere table of positive instances or negative instances (अदर्शनात् न दर्शनात्);—it is this method which we may term the Method of Subtraction (the Method of Difference in its negative aspect) that is the only exact and rigorous scientific Method. Such was the statement of the earlier Buddhists (cf. Uddyotakāra's and Vāchaspati's report of the Buddhist Doctrine of Inference—स हि प्रतिबन्धी न दर्शनमावावसीयः ।

तस्मात् तादात्म्यात्तदुत्पत्तिनिवन्धनः एव प्रतिबन्धः । यदाह कार्यकारण-
भावाद्वा स्वभावाद्वा नियामकात् । अविनाभावानियमोऽदर्शनात् न दर्शनात्
—a Buddhist Kārikā quoted in Vāchaspati, Udayana, Sriharsha, Mādhava, etc.)—कार्यकारणभावश्च इदम्—अस्मिन्
सति भवति—सत्सु अपि तदन्वेषु अस्मिन्नसति न भवति—एवमाकारः ।
न अन्वयव्यतिरेकाभ्यामतिरिच्यते ।... (एवं तादात्म्यामपि विपर्यये बाधक

प्रमाणीयपक्ष्या निवेतव्यम् ।...तस्मात् तादात्म्यादनुपपत्तिरिति प्रतिबन्धी
नान्यतः ।—Vāchaspati, *Tātparyyatīkā*, Chap I, A'hnika
1, Sutra 5, अनुमानसूत्रम्—व्याप्तिरहीपायः)

But the canon in this form is not sufficiently safe-guarded against possible abuse. Two points have to be emphasised :—(1) It must be carefully observed that no other condition is changed, (2) that the appearance and disappearance of *A* must immediately precede the appearance and disappearance of *B*. The definition of a cause is based on two fundamental characters, (1) the unconditional invariableness of the antecedence, and (2) the immediateness of the antecedence. The canon of the Method of Difference must therefore be stated in such a form as to emphasise each of these aspects. And one main difficulty in the practical application of the canon is that along with the introduction or sublation of an antecedent, some other phenomenon may be introduced or sublated unobserved. As a safe-guard against this radical vitiation of the Method, the later Buddhists formulated the canon of a modified Method, termed the *Panchakārani*, a Joint Method of Difference, which combines the positive and the negative Methods of Difference (the Method of Addition and the Method of Subtraction) in a series of five steps, and which equally emphasises the unconditionality and the immediateness of the antecedence as essential moments of the causal relation. This is

neither agreement in presence, nor agreement in presence as well as absence (the foundation of J. S. Mill's Joint Method of Agreement), but the Joint Method of Difference. The Panchakārani runs thus :—

The following changes being observed, everything else remaining constant, the relation of cause and effect is rigorously established :—

First step—The 'cause' and the 'effect' phenomena are both unperceived.

Second step—Then the 'cause' phenomenon is perceived.

Third step—Then in immediate succession, the 'effect' phenomenon is perceived.

Fourth step—Then the 'cause' phenomenon is sublated or disappears.

Fifth step—Then in immediate succession, the 'effect' phenomenon disappears.

Throughout, of course, it is assumed that the other circumstances remain the same (at least the relevant or material circumstances).

This Panchakārani, the Joint Method of Difference, has some advantages over J. S. Mill's Method of Difference, or what is identical therewith, the earlier Buddhist Method; and the form of the canon bringing out in prominent relief the unconditionality and the immediateness of the antecedence, is as superior from a theoretical point of view to J. S. Mills's canon,

and is as much more consonant than the latter to the practice of every experimenter, as the Hindu analysis of Anumāna as a Formal-Material Deductive-Inductive Inference is more comprehensive and more scientific than Aristotle's or Mill's analysis of the Syllogism (or Mediate Inference).

But even the Panchakārani is no sufficient answer to the question with which we started. The Panchakārani is only a method ; it shows only how in a particular case the relation of cause and effect is to be established (प्रतिबन्धवहीपाद्य). But we want more than this—we require a warrant for the process. The Buddhists therefore supply the following proof of the Method :—Doubt is legitimate, but there is a limit to doubt. When doubt lands you in an unsettlement of a fundamental ground of practice, and would thus annul all practical exercise of the will, the doubt must cease ; else the doubt would be suicidal or sophistical. In this particular case, when the Panchakārani is satisfied, the antecedent in question must be the cause, for there is no other antecedent to serve as cause ; the proof is indirect but rigid. If this be not the cause, there is no cause of the phenomenon. It was not, and it begins to be, without a cause ; which would be a contradiction of the rational ground of all practice, for all volitional activity proceeds by implication on the principle of causality. If things could happen

without a cause, all our motives to action would be baffled. The link between a presentation and the instinctive volitional reaction would snap, and the circuit of consciousness would be left incomplete. In fact, the Buddhists go further; they hold causal efficiency (कारिका) to be of the essence of empirical (relative) Reality. The proof of the Joint Method of Difference, then, lies in a strict application of the principle of causality in its negative form (*viz.*, there can be no phenomenon without a cause) and the truth of this last is guaranteed by the same ultimate criterion of empirical (relative) Reality as the truth of Perception itself, *viz.*, the correspondence between the rational and the practical activity of the self.

But invariable concomitance (or non-disjunction), the Buddhists argue, has another form, *e. g.*, the relation of the genus to the species. We may have perceived a hundred instances of the association of certain characters with certain others; we may also have never perceived the former when the latter are absent; but this would not enable us to generalise and establish invariable and unconditional co-existence. We must be first satisfied that there is identity of essence (वादाका सभाव). It is only when we perceive that the characters of a Sinsapá are co-inherent with the generic characters of a tree in the same individual object (a Sinsapá tree before me), and when we further

perceive that the characters are held together by the relation of identity of essence, that we can say that all Sinsapás are trees. For as there is identity of essence, a Sinsapá would not be a Sinsapá, if it were not a tree. It would lose its self-identity which is a contradiction. Hence the relation of identity of essence (तादात्म्य स्वभाव), as in the relation of the species to the genus, is the sole ground for establishing uniformity of co-existence (प्रतिबन्ध, स्वभावप्रतिबन्ध).

(For the Buddhist Method of Induction, in its later form, the Panchakáranī, vide Sarvadarsana Sangraha—Buddhist reply to the Chárváka attack on Inference :—

यदभ्यधाति अविनाभावी दुर्बोध इति तदसाधोयः। तादात्म्यतदुत्पत्तिभ्यामविनाभावस्य सुज्ञानत्वात्। तदुक्तं—कार्यकारणभावात् वा स्वभावात् वा नियामकात्। अविनाभावनियमोऽदर्शनात् न दर्शनात्। As for the Nyáya view अन्वयव्यतिरेकौ अविनाभावनिश्चायकौ इति।—the Buddhist objects—ननु पक्षे साध्यसाधनयोरव्यभिचारो दुरवधारणः भवेत्। भूते, भविष्यति, वर्तमाने अनुपलभ्यमाने च व्यभिचार-ग्रहाया अनिवारणात्।—the Nyáya retorts ननु तदाविधस्यले तावकीऽपि भवे व्यभिचारग्रहा दुष्परिहारा इति।—the Buddhist answers—मेवं बोधः, विनापि कारणं कार्यमुत्पद्यमानं इत्येवं-विधायाः ग्रहायाः व्याघातावधिकतया निवृत्तत्वात्। तदेव हि आशङ्कते यन्निग्राह्यमाने व्याघातादयः नावतरिषुः। तदुक्तं व्याघाता-वधिराग्रहा इति। तस्मात् तदुत्पत्तिनिश्चयेन अविनाभावी निश्चीयते। तदुत्पत्तिनिश्चयस्य कार्यहेतुः प्रत्यक्षोपलभ्यानुपलम्बपक्षनिवन्धनः।

कार्यस्य उत्पत्तेः प्रागनुपलब्धः, कारणीपलब्धे सति उपलब्धः, उपलब्धस्य पश्चात् कारणानुपलब्धात् अनुपलब्धः इति पञ्चकारण्या धूम-धूमध्वजयोः कार्यकारणभावः निश्चीयते। तथा तादात्म्यानिश्चयेन अपि अविनाभावः निश्चीयते। यदि शिंशपा वृक्षत्वम् अतिपतेत् स्वात्मानमेव जज्ञात् इति विपक्षे बाधकपक्षेः। अप्रवृत्ते तु बाधके भूयः सङ्गभावोपलब्धेऽपि व्यभिचारशङ्कायाः की निवारयिता। शिंशपावृक्षयोश्च तादात्म्यानिश्चयः वृक्षीयं शिंशपा इति सामानाधिकरण्यावस्थात् उपपद्यते। तस्मात् कार्यात्मानौ कारणम् आत्मानम् अनुमापद्यत इति सिद्धम्। Sarvadarsana Sangraha, Bauddha-Darsanam Vide also Sridhara Kandali.

The Nyāya Doctrine of Inference :—The Nyāya easily demolishes the Buddhist contention about identity of essence. The Nyāya writers, being realists, do not impugn the reality of the genus (जाति) like the nominalists or the nominalistic conceptualists ; but they point out that the inseparableness (or non-disjunction) in such cases can only be established by the experience of unbroken uniformity (व्यभिचारित्व i.e., by अन्वयव्यतिरेकी, दर्शनादर्शने). Uniform agreement in presence with uniform agreement in absence,—not the mysterious identity of essence irresistibly perceived in any individual case or cases—is the only basis for constituting genera and species in Natural Classification. Indeed some of the later Nyāya writers point out that individuals do not always possess in Nature all the characters that go to form the definition of the class to which they are referred.

Similarly, as regards the relation of cause and effect, a *nexus* is sometimes fancied to be perceived, a power in the cause to produce the effect (शक्ति), or an ultimate form (जाति सौप्ता), which is supposed to be present, whenever the effect (quality or substance) is produced (cf. Bacon's view of the 'Forms' of Simple Qualities). All this is neither a matter of observation nor of legitimate hypothesis. There is nothing except the invariable time-relation (antecedence and sequence) between the cause and the effect. But the mere invariableness of an antecedent does not suffice to constitute it the cause of what succeeds; it must be an unconditional antecedent as well (चन्द्रघासिद्धिग्न्यास नियतपूर्व-वर्तिता, being the definition of कार्यकारणभाव). For example, the essential or adventitious accompaniments of an invariable antecedent, may also be invariable antecedents, but they are not unconditional but only collateral and indirect, in other words their antecedence is conditional on something else (न स्वातन्त्र्येण). The potter's stick is an unconditional invariable antecedent of the jar, but the colour of a stick, or its texture or size or any other accompaniment or accident, which does not contribute to the work done (so far as we are considering it) is not an unconditional antecedent, and must not therefore be regarded as a cause. Similarly, the co-effects of the invariable antecedents, or what enters into the production of these

co-effects, may themselves be invariable antecedents but they are not unconditional, being themselves conditioned by those of the antecedents of which they are effects. For example, the sound produced by the stick, or by the potter's wheel, invariably precedes the jar, but it is a co-effect,—and A'kása (ether) as the substrate, and Váyu (air) as the vehicle, of the sound, enter into the production of this co effect, but these are not 'unconditional' antecedents, and must therefore be rejected in an enumeration of conditions or causes of the jar. Again, the conditions of the conditions, the invariable antecedents of the invariable antecedents, are not unconditional. The potter's father is an invariable antecedent of the potter who is an invariable antecedent of the jar, but the potter's father does not stand in a causal relation to the potter's handiwork. In fact, the antecedence must not only be unconditionally invariable, but must also be immediate (अव्यवहितपूर्वकालावच्छेदेन कार्यदेशे सत्त्वम्). Finally, all seemingly invariable antecedents which may be dispensed with or left out, are *ipso facto* not unconditional, and cannot therefore be regarded as causal conditions ; in short, nothing that is unnecessary is unconditional ; for this class, *vide* Visvanátha—नियतावश्यकपूर्वभाविनः अव्यवहितनियतपूर्ववर्तिन एव कार्यसम्भवे । तद्वत्तम् (अतिरिक्तं) अव्यवहितं—Visvanátha, Siddhánta Muktváli, on Sloka 20. For example, it is the custom to point to spatial position or direction with the

fingers, but finger-pointing, though invariably present, is not causally related to the perception of direction or spatial position, because we can imagine such perception without finger-pointing, (अन्यथासिद्धतया बहुव्या निर्देशस्य दिक्त्वचनेन न स्वाभाविकः सम्बन्धः, Vāchaspati, Tātparyya-Tikā, Chap. I, A'hnikā 1, Sūtra 5,—this shows that the doctrine of अन्यथासिद्धिग्रन्थ was long anterior to Gangesa).

[Visvanātha in the Bhāṣha-Parichchheda mentions five kinds of अन्यथासिद्ध, conditional antecedents—(1) येन सहपूर्वभावः (2) यस्य वा कारणमादाय (पूर्वभावः), (3) अन्यं प्रति पूर्वभावे प्राप्ते यत्पूर्वभावविज्ञानम्, (4) जनकं प्रति पूर्ववर्तिताम् अपरिज्ञाय यस्य (पूर्ववर्तिता) न गृह्यते, and (5) अद्यापि यत् नियतावश्यकपूर्वभावविनः अतिरिक्तम् भवेत् (एतेषु पञ्चषु आवश्यकत्वसौ—Slokas 19, and 20), यस्य स्वातन्त्र्येण अन्यव्यतिरेकौ न सतः किन्तु स्वकारणमादायेव अन्यव्यतिरेकौ गृह्येते तदन्यथासिद्धम्, Siddhānta Muktvāli, loc. cit.—The Dinakari points out that the first two cases are comprehended under the formula इतरान्वयव्यतिरेकप्रयुक्तान्वयव्यतिरेकशालितम्. There are several classifications of these irrelevant antecedents (अन्यथासिद्ध); I quote one of the best known].

The unconditional (अन्यथासिद्धिग्रन्थ) as interpreted in this comprehensive sense is a far more fruitful conception than Mill's, and is well adapted to its work—the elimination of the irrelevant factors in the situation. In the end, the discrimination of what is necessary to complete the sum of causes, from what

is dependent, collateral, secondary, superfluous or inert, (*i. e.* of the relevant from the irrelevant factors) must depend on the test of expenditure of energy. This test the Nyāya would accept only in the sense of an operation analysable into molar or molecular motion (परिस्फन्द एव भौतिको व्यापारः करीवर्धः—चतुर्द्वयम् व्यापारो नास्ति, Jayanta, Manjarī, A'hnikā I); but would emphatically reject, if it is advanced in support of the notion of a mysterious causal power or efficiency (शक्ति). This is a peculiarity of the Nyāya—its insisting that the effect is only the sum or resultant of the operations of the different casual conditions—that these operations are kinetic, being of the nature of motion, in other words holding firmly to the view that causation is a case of expenditure of energy, in the kinetic form,—but at the same time absolutely repudiating the Sāṅkhya conception of power or productive efficiency as metaphysical or transcendental (चतुर्द्वयम्), and finding nothing in the cause other than an unconditional invariable complement of operative conditions (कारणसामग्री) and nothing in the effect other than the consequent phenomenon which results from the joint operations of the antecedent conditions (समुद्दिष्टसकलकारकनिकरः परिस्फन्द एव—Jayanta—सामग्री कार्ये—सामग्रीकार्यत्वे तु कार्यमस्तु किमन्तरालवार्त्तव्या शक्त्या—Jayanta. *ibid*, A'hnikā, 1, शक्तिनिराकरणम्—it may be noted that the Nyāya, while repudiating transcendental power (Sakti) in the mechanism of nature

and natural causation, does not deny the existence of metaphysical conditions like merit (*पुण्यं*) which constitute a system of moral ends that fulfil themselves in and through the mechanical system and order of Nature—*vide* Jayanta, अतोन्द्रियं किमपि कारणं कल्पितमेव पुण्यादि—A'hnika 1, शक्तिनिराकरणम्).

The causal relation, then, like the relation of genus to species, is a natural relation of concomitance (व्याप्तिः स्वाभाविकः सम्बन्धः—Váchaspati) which can be ascertained only by the uniform and uninterrupted experience of agreement in presence and agreement in absence, and not by deduction from a certain *a priori* principle like that of Causality or Identity of Essence.

Nyāya objection to the Buddhist Method of Difference as a means of ascertaining causality.

Take for example the Buddhist deduction of Causality in any particular conjunction by means of the negative Method of Difference, or of the Panchakārani. The ascertainment of the causal relation by these Methods is open to the following objections :—(1) The unconditionality of the antecedent cannot possibly be ascertained. As the Chárváka rightly points out, the Methods enable you to eliminate irrelevant antecedents that are or can be perceived ; but the introduction or sublation of latent or undetected antecedents can be imagined against which the Method of Difference is powerless. In the case of the production of

smoke, for example, by fire,—what if I say that an invisible demon intervenes in every case between the fire and the smoke, that this demon (पिशाच) is the immediate antecedent and real cause of the latter, and that the fire is an accident which, in every such case, is brought about by its own causal antecedents ;—in saying this, I do not go counter to the principle of causality and am landed in no contradiction (व्याप्ति) such as strikes at the very roots of all practice, or baffles the completed circuit of consciousness, however much I may violate probability.

(2) In the second place, even supposing that the fire, in this particular case (which satisfies the Method of Difference rigidly) is ascertained to be the cause of the smoke, how can I know that fire is the cause in other cases, or that there is no other cause. You will perhaps argue that if there were an *indefinite* number of causes of the same specific phenomenal effect, it would violate the principle that phenomena are all conditioned, *i.e.*, exist only under certain conditions (कादाचित्कत्व),—which is more comprehensive than the principle of causality, and the contradiction of which equally overthrows all rational practical activity. Yes, I accept the conditionality of phenomena, but this is not violated by supposing that one specific assemblage of phenomena has more than one cause. It is true that if you suppose such plurality of causes, you cannot establish the invariableness of

the particular conjunction (green-wood fire and smoke) which your Method of Difference fixes upon as a case of cause and effect ; in other words, with your special principle of Causality so restricted; and without any general principle of Uniformity of Nature to fall back upon, you cannot ascertain, from the present case, or from any number of similar cases that you may have observed, that *all* green-wood fires are followed by smoke ; *i.e.*, you are helpless in demonstrating with apodictic certainty (or ascertaining indubitably) the relation of cause and effect. But this is an objection against your own position, not mine. Why not admit at once that certain phenomena are naturally connected (as invariable concomitants or antecedents) with other phenomena, and take your stand on observed concomitance (uniform and uninterrupted experience of agreement in presence as well as absence) without assuming causality as an *a priori* principle and making deductions therefrom, and without the trouble of ascertaining the relation of cause and effect in every individual case. I am free to admit that theoretical objections of irresistible force (like those of the Chárváka Sceptics) can be urged against this ascertainment of universal invariable and unconditional concomitance (अविच्छेदोपाय) on the basis of mere observation. Doubts of this kind can no more be laid by my view of the matter than by your canons of causality and essential

identity (तदुत्पत्ति and तादात्म्य). Ultimately we all have to fall back on the rational practice of thinking persons (प्रेक्षावन्तः), and such persons are always content to act on practical certitude instead of hankering after an unattainable apodictic certainty in the affairs of life (प्रामाणिकलोकायामनुपालयता यथादर्शनं शङ्कनौघम्). This same practical certitude is also the ultimate warrant of the Deductive-Inductive Inference by which we ascertain the characters of things without direct perception and through the medium or instrumentality of a mark.

[To the earlier Buddhist canon of the Method of Subtraction, *i. e.*, the negative Method of Difference, Uddyotakara and Vāchaspati of the Nyāya School pertinently and acutely object as follows :—

सर्वं यत् किञ्चित् कश्चित् दृष्टं तस्य यत् प्रतिबन्धः, तद्विदः तस्य तत् समकं तव इति अनुजानीमः । स एव तु प्रतिबन्धी न तावत् तदुत्पत्त्या सम्भवति । का पुनरियं तदुत्पत्तिः । धूमस्य किं वज्रानन्तरं भावः । स तादृशः अस्ति रासभस्यापि । तत्प्रतिबन्धीऽपि धूमः स्यात् । अयं तदनन्तरमेव भावः, न च रासभानन्तरं भवन्नपि तदनन्तरमेव भवति, तस्मिन् सति अपि असति अग्नौ तदभावात् । असति अपि तस्मिन् सत्याद्रेश्चभवति वज्री तदभावात् । अथ यद्यपि धूमस्य वज्रभावानुविधानं ततोपलब्धं, तथापि देशान्तरादिषु तदभावीऽस्य कुतश्च्यः । तथा हि भूयो भूयो रासभं दृष्टे धूमी दृष्टः, तदभावे च अदृष्टः, न स तत्कार्यः । तज्जातीय-स्यैव धूमस्य रासभं विना सति वज्री भावात्, एवं सत्यपि अग्नौ पिशाचेन जनिती धूमः, कचिद्देशादौ तज्जातीय एव रासभवद्वज्रभावेऽपि पिशाचादेव भविष्यति, इति अवश्यं शङ्क्या भाव्यं नियामकम् अपश्यताम् । न च सति

भावमात्रं नियामकं, तस्य रासभादिषु अवशिषात् । तदनन्तरमेव इति च अवधारणस्य शङ्कायामभावात् । अवधारणेन तु शङ्कापनयने परस्परसंशय-प्रसङ्गात् ।

Buddhist reply :—स्यादितत् । यो यो धूमो हटः स सर्व्वसावत् आग्नेश्चनसहितवज्रानन्तरमेव, न पिशाचानन्तरं । स च कादाचित्कतया निमित्तमपेक्षमात्रो यदनन्तरमेव गम्यते तदेव अप्रतीत्यभिचारं निमित्तं करोति, न तु प्रतीत्यभिचारं रासभादि । नापि सर्व्वथाऽनुपलब्धपिशाचादिः । यदि न तन्निमित्तं कथात् विनाऽपि बह्विं क्वचित् धूमो न उप-लभ्यते । अथ असौ (पिशाचः) सर्व्वथा बह्विसहितः तथा सति आग्नेश्चन-वत् कथं बह्विरपि न कारणम् । कारणं चेत् कथं तमन्तरं धूमभावशङ्का । Now the phenomenon that is contingent (कादाचित्क) cannot be uncaused—अकारणस्य हि कार्य्यस्य नित्यं सत्त्वं असत्त्वं वा स्यात्, अनपेक्षत्वात् न कादाचित्कत्वम् । And with the limitation of a specific effect, there must be only one specific cause, for an unrestricted plurality of causes would amount to the denial of uniformity in causality (i. e., of the *unconditional invariable* antecedence)—

नापि अनेकं कारणं, अकारणत्वप्रसङ्गादिव । वज्रानन्तरमेव भाव इति हि धूमस्य वज्रकार्य्यत्वम् । स चेत् अवहृरपि अनन्तरं, न एवकारार्थः स्यात्, इति न बह्वेः कार्य्यम् । एवम् अन्यस्यापि न कार्य्ये । न हि अन्यानन्तरमेव भवति, बह्वेरपि अनन्तरं भावात्, ततश्च अहेतुको धूमः स्यात् । तथा च कादाचित्कत्वस्याऽऽतिः ।

Nyāya rejoinder :—सत्यम् । यद्यपि विना बह्विं नीपलब्धो धूमः, यद्यपि च पिशाचानन्तरं नीपलभ्यते तेषामनुपलब्धेः, तथापि पिशाच-

कार्यं एव धूमः । तच्च तत्र वहुः कुतश्चित् सङ्घटोः उपनिपतितः, रासभ इव,
न धूमस्य जनकः । तेन तदभावेऽपि तज्जातीय एव कारणमिदजन्मा
कदाचित् कादाचित्की धूमः स्यात् । इति अनिष्ठतिरेव शङ्कायाः ।
न च दृष्टसम्भवे नादृष्टं कल्पयितुं युक्तम् इति शक्यं मर्षाद्वर्तुम् । अनुप-
लब्धिलक्षणप्राप्तस्य अग्रकानिराकरणत्वात् (vide Nyāya Vindu) । न च
अनुपलब्ध्यान्तराणि अपि तन्निषेधे प्रभवन्ति । तस्मात् अनन्तरमेव इति
अवधारणाभावात् नैव कार्यकारणभावावधारणं युक्तम् । न च यदन्य-
सङ्घितानन्तरं उपलब्धं तत्, तदन्यरहितात् तस्मात् भवत् भिन्नजातीयं भवति ।
उक्तं हि रामभसङ्घितात् बहुः यादृशी धूमः तादृश एव तद्वरहितात् बहु-
रिति । तस्मादेवंविधा शङ्कापिशाची स्निवारकं तदुत्पत्तिनिवयमास्तन्दती
न शक्या निवारयितुम् ।

The Nyāya proceeds to point out that what is contingent need not necessarily be produced by a cause. It is enough if there is natural connection with something else, a relation of antecedence and succession (or concomitance), without any element of productive efficiency or causation.

अपि चान्तु तदुत्पत्तिनिवयः तथाऽपि कस्मात् कारणमन्तरैव न कार्ये
भवति । तथा च सति अनपेक्षतया कादाचित्कलविद्धतिः इति चेत् ।
अन्तु तर्हि सम्बन्धः साभाविकतया अन्यानपेक्षः अव्यभिचारि गमकत्वाद्गम् ।
स च यो वा स वा भवतु । कृतं कार्यकारणभावावधारणायासेन । यथा
चेत्तत् तथा अये दर्शयिष्यामः । Vāchaspati, Tātparyya-Tikā,
Chāp. I, A'hnikā 1, Sutra 5, व्याप्तिवहीपायविचारः ।

The Nyāya analysis of the causal relation continued :—Co-effects :—In the enumeration of dif-

ferent varieties of irrelevant antecedents (अनव्यासिद्ध), we have already noticed that co-effects of the same Cause are apt to be confounded as cause and effect. In some cases, the co effects may be simultaneous, *e.g.*, the case of the ascending and the descending scale in a balance, which are co-effects of gravity (*vide* Pārtha-sārathi Misra on Kumārila, Sloka Vārtika—तुलानमनोदमनयोस्तु न निघः कार्यकारणत्वम्, उभयोरैककारणत्वात्,—sloka 157, Sūnya-Vāda). In other cases, the co-effects may be successive effects of the same cause, and here the risk is great of mistaking the antecedent co effect to be the cause of the succeeding co-effect ; *e.g.*, the case of ants moving in a line to carry their eggs upward, which is observed before the summer rains ;—where the movement of ants and the rains are not cause and effect, but successive effects of the same cause, *viz.*, the heat (उष्ण), which disturbs the elements, *viz.*, the earth and the atmosphere (महाभूतक्षोभ) ; the ants being affected by this heat earlier than the atmospheric movements which bring the clouds and the rain.

(Uddyotakara, and Vāchaspati—न च पिपीलिकाण-
मचरणं वयस्य कारणमनुपलब्धमस्मात् । असत्यपि तस्मिन्
वयस्योत्पत्तेः । वयस्यकारणस्य तु महाभूतक्षोभस्य पिपीलिकाणमचरणं
पूर्वकार्यम् । कथ्यमानाः खलु पिपीलिकाः भूमिनीधरा खानि चण्डानि
भूमिष्ठानि उपरिष्ठात् नयन्ति—Tātparyya—Tikā II, 2, Sutra
37).

Synchronousness of Cause and Effect.—This is resolved into a case of simultaneous co-effects of the same ultimate cause, *e.g.*, the ascent of one scale and the descent of the other in the balance, which are not related as cause and effect, but are simultaneous effects of gravity. In other cases, the synchronousness is only apparent, the interval between the antecedent and the consequent being too small (दृष्टकाल) to be apprehended (योगपद्याभिमान) *e.g.*, in the case of the needle piercing a hundred soft lotus petals laid one upon another, where the steps are really successive; or the illumination of the whole room by the light of a lamp, where the succession is unperceived owing to the inconceivable velocity of light (cf. Kumárilá, Sloka-Varttika,—हेतुहेतुनतां सिद्धं योगपद्या-निदर्शनम्.—यत् प्रदीपप्रभाद्युक्तं, दृष्टकालोऽस्ति तव नः। दुर्लभं यथा शेषः पद्मपत्रव्रते तथा। Sūnyavāda, Sloka 156-157.—I quote Mimāṃsā authorities, but the view is common to the Mimāṃsā and the Nyāya-Vaiśeṣika).

The time-relation in a chain of causes and effects :—A careful study of the time-relation in a chain of causes and effects is a peculiarity of the Vaiśeṣika system (and the later Nyāya). A moment (ultimate unit of time, Kṣana, क्षण) is defined to be the time-interval between the completion of the sum of conditions and the appearance of the effect. The Vaiśeṣika conceives the unit to be determined by reference to the division

of one atom from another (विभावाद्गुणपादविभावाद्
 प्रागभावसम्बन्धकालोऽवधिद्वयः कालः सप्तः—Sapta Padārthī, Sivā-
 ditya ;—i.e., the ultimate unit of time is the time
 during which motion exists in an atom prior to its
 division from another atom, in a case of division
 due to motion). The Sāṅkhya, we have already
 seen, determines this ultimate unit by reference to
 the motion of a Tanmātra.

The number of such units will determine the
 time-interval between a given set of physical condi-
 tions and a particular effect, for between a so-
 called sum of causes and a so-called sum of effects,
 there intervenes a series of atomic (or molecular)
 motions, with conjunctions and disjunctions which
 form the causal chain. However crude in the
 practical application, the fundamental idea is, in
 connection with the principle of work and energy
 (for which both the Sāṅkhya and the Nyāya-
 Vaisesika furnish a rudimentary basis), immensely
 suggestive of a possible Time Calculus.

Plurality of Causes :—This will be discussed,
 when we consider the relation of Vyāpti to the
 principle of Causality.

The Nyāya Ground of Inference—Vyāpti नियत-
 साधर्म्य—Vāchaspati) :—Inference, then in the
 Nyāya, depends on the ascertainment, not of the
 casual relation, nor of the relation of genus to spe-
 cies, but of a natural relation, between two pheno-
 mena, of invariable and unconditional concomitance

(उपाधिबिधुरः साभाविकः सम्बन्धः व्याप्तिः—Uddiyotakara and Vāchaspati). Of the two phenomena so connected, one is called the Vyāpya or Gamaka (the sign, mark or indicator), and the other Vyāpaka or Gamyā (the thing signified, marked, or indicated). In the relation of fire and smoke, for example, smoke is the Vyāpya or Gamaka (sign or mark); and fire, the Vyāpaka or Gamyā the thing signified or marked). Now the relation of Vyāpti between *A* and *B* may be either unequal or equipollent (विषमव्याप्ति or समव्याप्ति). When *A* is the sign of *B*, but *B* is not the sign of *A*, the Vyāpti is one-sided or unequal, and here a Vyāpti is said to exist between *A* and *B*, but not between *B* and *A*. For example, smoke is a sign of fire, but fire is not universally a sign of smoke. When, therefore, the relation of Vyāpti is an unequal one, as between smoke and fire, it is expressed in the proposition :—Wherever the Vyāpya (sign or mark, *e.g.*, smoke) exists, the Vyāpaka (the thing signified or marked, *e.g.*, fire) also exists. From this it follows by necessary implication (a sort of चर्चापत्ति) that whenever the Vyāpaka (*e.g.*, fire) is absent, the Vyāpya (*e.g.*, smoke) is also absent (व्यापकाभावे व्याप्याभावः). Again the Vyāpti may be a mutual or equipollent one, *i.e.* *A* and *B* may be signs of each other, *e.g.* green-wood fire and smoke. Here each in turn is Vyāpya and Vyāpaka, and this is expressed in

the two propositions :—(1) Wherever there is smoke, there is green-wood fire, and (2) wherever there is green-wood fire, there is smoke. By necessary implication it follows—(1) where there is no green-wood fire, there is no smoke : (2) where there is no smoke, there is no green-wood fire. We have seen that a Vyápti exists between smoke and fire, for wherever there is smoke, there is fire. But we cannot say that a Vyápti exists between fire and smoke, for we cannot say that wherever there is a fire, there is smoke. The combustion of an iron-ball (*अवनीलक*), for example, is a case of fire without smoke. But it would be correct to say that a Vyápti exists between green-wood fire and smoke, as well as between smoke and green-wood fire. The question, therefore, is—What is the relation between fire and smoke ? The relation between fire and smoke is a conditional relation ; i.e., on condition that the fire is green-wood fire, it would be a sign of smoke. In other words, a Vyápti implies unconditional invariable concomitance, and the relation between fire and smoke is not therefore a Vyápti (natural unconditional concomitance), for fire requires a ‘condition,’ *Upádhi. viz.*, green-wood, to be followed by smoke. Smoke, on the other hand, requires no ‘condition’ to indicate fire. For the purposes of Inference, therefore, relations between phenomena may

be considered as of two kinds :—(1) Contingent conditional relations, holding good on the fulfilment of a certain condition or Upádhi. and (2) Vyápti, or unconditional invariable relation, between a mark and that which it makes, a relation without any Upádhi or determining condition (उपाधिविधुरः सम्बन्धः). It is this latter kind of relation that serves as the ground of Inference. If we can ascertain that a Vyápti exists between *A* and *B*, then *A* is a sign of *B*, and an inference of the presence of *B* from the presence of *A*, and of the absence of *A* from the absence of *B*, would be warranted. The question, therefore, is—how to ascertain the relation of Vyápti between two phenomena.

Ascertainment of Vyápti according to the early Nyáya (आदिशङ्खोपाय).—Briefly speaking, the observation of agreement in presence (सम्बन्ध) as well as agreement in absence (अतिरेक), between two phenomena, with the non-observation of the contrary (अभिचारादर्शनम्), is the foundation of our knowledge of Vyápti (दर्शनादर्शने—Váchaspati). This suggests a natural relation (स्वाभाविकसम्बन्ध—Váchaspati) of invariable concomitance (नियतसादृश्य—Váchaspati) between the phenomena, which is fortified by our non-observation (अदर्शन) of the contrary (अभिचार). But this does not establish the unconditionality of the concomitance (उपाधिविधुरसम्बन्ध), which is essential to a Vyápti. We have therefore to examine the cases carefully

to see if there is any determining condition (Upādhi—i. e. some hidden or undetected but really operative or indispensable accompaniment) which conditions the relation between the supposed sign or mark (Gamaka) and the supposed signate (thing signified, Gymya). Now let us consider what constitutes an Upādhi. It is a circumstance which always accompanies, and is always accompanied by, the supposed signate (the thing signified, Gamya), but does not invariably accompany the supposed sign or mark (Gamaka). If, therefore, in the set of positive instances where both the sign and the signate are present, nothing else is constantly present, there can be no Upādhi. Or, again, if in the set of negative instances where both the sign and the signate are absent, no other material circumstance is constantly absent, there is no Upādhi. This follows from the very definition of an Upādhi. It is impracticable to fulfil these requirements rigorously. Still, every one of the accompanying circumstances (of course the likely ones) may be taken successively, and it may be shown that the concomitance continues even when the suspected Upādhi (अद्वितीयपक्षि) is absent, and therefore it cannot be the Upādhi. And this is to be fortified by the observance of uniform and uninterrupted agreement in absence (Vyatireka) between the two concomitant phenomena. In this way, when we have disproved all

suspected Upādhis, we conclude by establishing the Vyāpti. It is true that we may still go on doubting. But doubt has a certain limit for the 'experimenter' and the thinking person (परीक्षक, प्रेक्षावान्). When doubt overthrows the foundation of all rational practice (सामाजिकजीवनाय), or leads to a stoppage or arrest of all practical activity (जीव्यवहार), it stands *ipso facto* condemned, and must be abandoned (व्याघातावधिरागदा). Śrīharsha and Udayana—व्याघात is mentioned by Vāchaspati). Thus it is that Vyāpti is ascertained. In this way, we observe innumerable instances of Vyāpti. Now by means of repeated observations of this kind (सूक्ष्मदर्शन), we have established the principle of the Uniformity of Nature (समावृत्तिवन्), and also of Causality; and these two principles thus ascertained may be made use of in their turn as the basis of an argumentation or deduction (Tarka, U'ha, तर्क) to confirm a particular Vyāpti in a particular case. Tarka or U'ha, then, is the verification and vindication of particular inductions by the application of the general principles of Uniformity of Nature and of Causality, principles which are themselves based on repeated observation (सूक्ष्मदर्शन) and the ascertainment of innumerable particular inductions of uniformity or causality (सूक्ष्मदर्शनजनितसंस्कारसहितम् इन्द्रियेनैव सामाजिकसम्बन्धवाहि—Vāchaspati). Thus Tarka also helps in dispelling doubt (सन्देह). Śrīharsha,

however, questions the validity of this verification, —cf. the well-known couplet ending तर्कः ब्रह्मविधिः कुतः ।

It will be seen that the process of disproving all suspected Upádhis (उपाधिब्रह्मनिरास), in the early Nyáya, answers exactly *as a process* to Mill's Method of Agreement. In fact, the disproof of a suspected Upádhi by pointing to instances of Agreement in absence (अन्वय) even in the absence of the Upádhi, fortified as this is by the instances of agreement in absence (व्यतिरेक), virtually amounts to Mill's Joint Method of Agreement. But the fundamental difference is this :— Mill's Method of Agreement is formulated in view of the phenomena of causation (including co-effects, etc.) and, as usually enunciated, confessedly breaks down in dealing with cases of Uniformities of Co-existence unconnected with Causation; the Nyáya Method based on the disproof of suspected Upádhis is a more daring and original attempt, and is far more comprehensive in scope, being applicable to all Uniformities of Co-existence and of Causation alike. And this the Nyáya successfully accomplished, by introducing the mark of unconditionality (उपाधिविधुरता) into the relation of Vyápti (Concomitance), even as the same mark of unconditionality (अन्वयविविधव्युत्पत्तिता) had been previously introduced into the definition of Causality (कार्यकारणभाव). The difference between the early Nyáya and the Buddhist systems

may be briefly put thus :—The former relied on empirical induction based on uniform and uninterrupted agreement in Nature, and accordingly regarded the Method of Agreement as the fundamental Method of Scientific Induction, founding Inference on Vyápti to which they subordinated Causality in the doctrine of Method; the latter assumed two *a priori* principles, viz., causality and identity of essence, deduced the canon of the Method of Difference by an indirect proof from the principle of causality, and made this Method the foundation of all scientific Induction of Causality, just as they based all natural classification of Genera and Species on their *a priori* principle of Identity of Essence.

[Text from the early Nyáya :—

Method of Agreement and the Joint Method without the device of the Upádhi :—

Cf. Jayanta on सादृश्यं—तस्मिन् सत्येव भवति न विना भवनं ततः । अयमेवाविनाभासो नियमः सदृशरिता । ‘तस्मिन् सत्येव’ ‘only this remaining throughout,’ while others change—implying the Method of Agreement. The set of positive instances, in which this antecedent alone is constant, must be supplemented by a set of negative instances (agreement in absence) :—व्यतिरेकनियममन्तरि च प्रतिबन्धवद्वष्टानुपपत्तेः । नियमस्यायं उच्यते यत् तस्मिन् सति भवनं ततो विना न भवनं इति भूयोदर्शनम् । तच्च तस्मिन् सति भवनं इत्यन्वयमात्र-

परिच्छेदात् अहंमह्यतीति नियमः स्यात् । ततो विना न भवनं इत्यस्य
अर्थस्य अपरिच्छेदात् इति Jayanta, A'hnika II, व्यतिरेकव्याप्ति-
नियमावश्यकत्वम् ।

Doctrine of the Upādhi :—Unconditional concomitance distinguished from conditional :—

यो वा स वा अस्तु सम्बन्धः यस्य असौ स्वाभाविको नियतः स एव समकः,
गम्यस्य इतरः सम्बन्धीति युज्यते । तथा हि धूमादीनां वज्रादिसम्बन्धः
स्वाभाविकः । नतु वज्रादीनां धूमादिभिः । उपपन्नस्य ते हि विनापि
धूमादिभिः । यदातु आर्द्रैश्चनादिसम्बन्धम् अनुभवन्ति तदा धूमादिभिः सह
संबन्धन्ते । तस्मात् वज्रादीनाम् आर्द्रैश्चनाद्युपाधिगतः सम्बन्धो न स्वाभा-
विकः । ततो न नियतः । स्वाभाविकस्तु धूमादीनां वज्रादिसम्बन्ध उपपत्तेः
अनुपपन्नस्यमानात् क्वचित् व्यभिचारस्य अदर्शनात् अनुपपन्नस्यमानस्यापि
कल्पनानुपपत्तेः । अतो नियतः सम्बन्धः अनुमानाद्वम् ।

Concomitance sufficient without causal *nexus* :—

The Buddhist objects—In Nature, everything is connected with everything else. Hence if there were no *nexus* of causality between antecedent and consequent, everything might follow from everything else. The Nyāya replies—You admit uniformities (of co-existence, etc.) other than causal ;—so you confess that a natural fixed order can exist without causal *nexus*.....

An Upādhi, how established and how disproved :—

The Nyāya then proceeds to show how an Upādhi

is established, or how disproved by observation.—
 तत्र वदते: अनार्देन्वतस्य विना धूमन् अयोगोलकादी दर्शनात् चार्देन्वनो-
 पाधिः अस्य धूमेन सम्बन्धः न तु स्वाभाविक इति नियोयते । धूमविशेषस्य
 तु विना वदितुम् अनुपलब्धात्, उपाधिमेदस्य च अदृश्यमानस्य कल्पनायां
 प्रमाणाभावात्, विशेषकृत्यपेक्षस्य च संशयस्य अनुपलब्ध्यपूर्वं अनुत्-
 पादात् उत्पत्तिं च अतिप्रसङ्गात् प्रेषावत् प्रत्युत्पत्तेर्दात्, स्वाभाविकः
 सम्बन्धः अवधार्यते ।

General Method of Induction by exhaustion
 of the Upādhi, more comprehensive than Mill's
 Joint Method :—

For the definition of an Upādhi, vide Srīharsha and
 Udayana : अन्वयसाधनो यः साध्यसमव्याप्तिः उच्यते स उपाधिरिति ।
 Hence to avoid an Upādhi (which is साध्यसमव्याप्तिः),
 the constant presence of anything relevant other
 than the sign and the signate in the positive ins-
 tances (of agreement in presence, अन्वय), and the
 constant absence of any such thing in the negative
 instances (of agreement in absence, व्यतिरेक) must
 be safe-guarded against. This amounts to Mill's
 Joint Method.

Suspicion of non-perceptible Upādhi—Limits of
 legitimate Doubt :—

न च अदृश्यमानीदपि दर्शनानर्हत्तया साधकबाधकप्रमाणाभावेन
 संदिग्धमान उपाधिः स्वाभाविकत्वं प्रतिवध्नाति इति साम्प्रतम् । अत्र
 शङ्कया भवितव्यं नियामकाभावादिति दत्तावकाशा खलु इदम्
 प्रमाणमन्यादातिक्रमेण शङ्का पिशाची लब्धप्रसरा न कश्चित् नास्तीति नेयं

कश्चित् प्रवर्तेत। सर्व्वमेव कश्चित् कश्चित् अनर्थस्य शङ्कास्यदत्तात्। अनर्थशङ्कायाश्च प्रेषावतां निवृत्त्यदत्तात्। अन्तः खिन्नाप्रपानोपयोगेषु अपि सरसादिदर्शनात्। तथात् प्रामाणिकलोकयाताम् अनुपासयता यथादर्शनं शङ्कनीयम्।.....तथादुपाधिं प्रयत्नेन अन्विष्यन्तोऽनुपलभमाना नास्तीति अवगम्य स्वाभाविकत्वं सम्बन्धस्य निश्चिनुमः।—

Tarka, U'ha,—Deductive verification of particular inductions by applying the two fundamental inductions of Uniformity of Nature, and Causality :—Doubt finally dispelled :—

Now innumerable particular uniformities of this kind (Vyáptis) are observed, and as a result of this repeated observation, a belief in the Uniformity of Nature (स्वभावप्रतिबन्ध), as well as in the principle of Causality (कार्यकारणभाव) is generated in the mind, a belief which has evidential value and validity. It is not intuition (न ज्ञानसम्) but a mental pre-disposition based on uniform and uninterrupted experience (भूयोदर्शनजनितसंस्कारसहितम् इन्द्रियमेव स्वाभाविकसम्बन्धयाहि,—अथं भूयोदर्शनम् असाधारणम् इति प्रमाणात्तरं जातम्). Then armed with these new resources, the belief in uniformity and in causality as general principles, we proceed to fortify our particular inductions (Vyáptis), whether of uniformity of nature or of causality, by indirect deduction from these general principles :—We argue if, under these observed circumstances, *A* were not the mark of *B*, the principle of uniformity of nature would be violated,—Nature would not be uni-

form.—or, if under these observed circumstances *A* were not the cause of *B*, the principle of causality would be violated, the phenomenon *B* would be without a cause ;—and such indirect proof (तर्क, कृद्) gives us the overwhelming probability which we call practical certitude, and on which every reasonable man (every thinking and judging person) proceeds to act in due natural course.—
 स्वभावात्प्रतीतिवद्वा हेतवः स्वसाध्येन, यदि साध्यमकरिष्य भवेद्युः, स्वभावादेव प्रत्यक्षैरतिरिचि तर्कसहायः अनिरुक्तसाध्यव्यतिरेकवर्तमानसंदेहा यत्र दृष्टाः, तत्र स्वसाध्यम् उपस्थापयन्त्येव । Vāchaspati I, 1, Sutra 5 ;
 cf. also, I, 1, Sutra 40—कृद्ः कारणास्तीपपक्षा संभवेन प्रायते । कारणासम्भवे कार्यस्य असत्त्वात् ।]

Instances of Vyāpti (uniformity) not comprehended under Causality, or the relation of Genus and Species :—The Nyāya points out that the relations of cause and effect and of genus and species do not exhaust the grounds of Inference. There are cases of Inference based on Vyāpti (i. e., on invariable and unconditional concomitance) which come neither under Causality (तदुत्पत्ति) nor under Identity of Essence, (तादात्म्य). Vāchaspati notes that to-day's sunrise and yesterday's sunrise, the rise of the moon and the tide in the ocean, the relative positions of the steller constellations, are instances of Vyāpti (invariable concomitance) between phenomena which are neither related as cause and effect, nor as genus and species. Jayanta adds the conjunction of sun-set with the appearance of the stars,

of ants moving in procession (with their eggs) with the approach of the rains,—of the rising of the constellation Agastya (Canopus) above the horizon with the drying up of rivers; of the spring tide with the full moon; and dismisses as sophistical and far-fetched the Buddhist attempt to explain all these cases by means of causality. We have seen that the Nyāya and the Mīmāṃsā reduce most of these conjunctions to cases of co-effects of the same cause, co-effects which may be either simultaneous or successive.

अपि च अद्यतनस्य सवितुर्दयस्य चास्तनेन सवितुर्दयेन, चन्द्रीदयस्य च समानकालेन समुद्रवृद्ध्या.....न कार्यकारणभावः तादात्म्यं वा । अद्यच दृष्टौ स्यमकभावः ।—Vāchaspati, Tātparyya-tīkā, I, 1, Sūtra 4 ;—Cf. also Jayanta, Nyāya Manjarī—अन्वेषामपि हेतुर्ना भूत्वा अनति दर्शनात् । सूर्यास्तमयमास्तौक्यं कल्पते तारकीदयः । पृथंचन्द्रीदयादृष्टिरन्वुत्तरवगम्यते । उदितेनानुमीयन्ते सरितः कुम्भयोनिनः । यद्यत्पुलिनपथ्येन विद्यान्तस्त्रयपङ्क्तयः । पिपौलिकाश्चसुखारचेष्टानुमितवृष्टयः । भवन्ति पथिकाः परं कुटीरकरचोद्यताः ।

Vyāpti between Cause and Effect :—Relation of causality to Vyāpti :—

On the Buddhist (and early Nyāya) view that one specific assemblage of 'effect' phenomena has one specific assemblage of causal conditions, there would be two aggregates, the sum of causal conditions (कारणसामग्री), and the sum of effects (कार्य-सामग्री). For example, fire requires green-wood to complete the sum of causal conditions to give rise to smoke with some particular marks (धूमविशेष,—

वह्न्यपास्तुतादिधर्माविशिष्ट, Jayanta II ; compare Gangesa कृष्णगुहप्रभववद्विमानयं कटुकामुरभिपास्तुरधुमवत्त्वान् ।— Chintāmani, Anumana, Viruddha Siddhānta). Here, between an effect and a single condition (termed a cause) there is a relation of Vyāpti. The effect is Vyāpya or Gamaka (the sign or mark) ; the cause (or condition) is Vyāpaka or Gamyā (the thing signified). In other words the presence of the effect indicates the presence of the causal condition, and the absence of the causal condition will by implication indicate the absence of the effect. Smoke of this particular kind is supposed to be an effect of which there is one and only one assemblage of causal conditions (fire and green-wood) ; hence where there is smoke, there is fire ; and when there is no fire, there is no smoke.

Now introduce the complication of the plurality of causes :—Fire, for example, is the effect of several assemblages, *e. g.*, (1) blowing on heated grass, (2) focussing rays through a lens on a combustible like paper or straw, (3) friction with the fire drill, etc. Here each assemblage is regarded as a sum of causes. But in this case there is no Vyāpti between the effect 'fire' and any particular assemblage of causal conditions, say, of the lens or the fire drill. For the presence of fire does not indicate the presence of the lens or the fire drill assemblage, nor does the absence of either of the latter in particular, indicate the absence of fire.

Indeed in such a case, the effect 'fire' is not a mark or sign (Gamaka or Vyápya) of any one in particular of the different possible causal assemblages, though each of these particular assemblages of causal conditions is a mark or sign (Gamaka or Vyápya) of fire.

The plurality of causes requires a further consideration in the light of the definition of the causal relation. A cause is defined to be the unconditional invariable antecedent. From the unconditionality, it follows that the entire sum of conditions, and not one single condition, is, properly speaking, the cause. In view of the plurality of causes, an invariable antecedent must be taken to mean that any particular cause (i. e., assemblage of causal conditions) is invariably followed by the effect,—not that the effect is invariably preceded by any particular cause.

Popularly, a single condition, say the lens or the fire-drill, is said to be a cause of fire; but, in view of the plurality of causes, this is apt to be misleading, as there is no Vyápti in this case: the lens or the fire-drill is no more a mark of fire than fire is a mark of the lens or the fire-drill.

The plurality of causes strains the definition of a cause, and undermines the relation of Vyápti between an effect and a cause. Any particular cause (causal aggregate) still indicates the effect, but not *vice versa*. The earlier Nyáya (down to

Váchaspati and Jayanta) obviated the plurality, as we have seen, by introducing distinctive marks in the effect such as would indicate a single specific cause (कार्यवैलक्षण्य or कार्यभेद indicating कारणवैलक्षण्य or कारणभेद). Some indeed went further and held that when the antecedent causal assemblages differ in kind, the effect phenomena, though apparently the same, do really differ specifically (or in kind)—कारणवैजात्यात् कार्यवैजात्यम् । But the Nyáya discards this hypothesis ; the fire is the same, though the possible causes (or causal aggregates) differ, *e. g.*, the lens, the drill, etc. But the effect phenomenon to which we attend is not the only effect ;—in the case of plurality of causes, we must carefully examine the accompaniments of the effect, *i. e.*, the sum of effects, and the examination will shew some distinctive or specific circumstance or accompaniment which will enable us to definitely determine the particular assemblage of causal conditions that must have preceded in the case under examination. This is the device of the earlier Nyáya as well as of the Buddhists, as we have seen ; but the later Nyáya doubts the practicability as well as the theoretical validity of such a step on an unrestricted assumption of the plurality of causes, and feels troubled by the circumstance that no effect for which more than one cause (or causal aggregate) can be assigned, can be regarded as a mark or sign (Gamaka or Vyápya) of any one of

the causes in particular. Accordingly, some adherents of the later Nyāya advanced the proposition that when more than one causal aggregate can be supposed for any effect, the latter is a mark or sign (Gamaka or Vyāpya), not of any one of the causal aggregates in particular, but of one or other of them; and the absence, not of one such cause, but of each and every one of them, alone indicates the absence of the effect. A cause therefore should be defined to mean *one or other* of the possible alternative aggregates which, being given, the effect follows invariably and unconditionally. If we ask what is the defining mark (or quiddity) of the cause (कारणत्वव्येदक), we are told that it is *one-or otherness* (अन्यतमत्व), and nothing else; others cut the Gordian knot by assuming that the different possible causes of the same effect possess a common power or efficiency (चत्तिरिक्तशक्ति), or a common 'form' (जातिसौच्चा), which accounts for the production of a common effect. The latter is therefore a sign or mark of this power (शक्ति), or this form (जातिसौच्चा), which is manifested by each of the causal aggregates. This hypothesis (कल्पना), they hold, is simpler and more plausible than the hypothesis of specific differences latent in the apparently identical effect of a plurality of causes (कारणवेज्ञानात् कार्यवेज्ञानम्).

(Cf. Dinakarī on the Siddhanta Muktaṭvali—केचित्तु
वक्ति' प्रति ह्यप्युक्तकार-संयोगादीनां ह्यप्युक्तकारसंयोगादिवदेव

कारणतया अभिचारेण असम्भवात् अतिरिक्तशक्तिसिद्धिः । न च
तद्वस्तुकारणोः अरणिनिर्मयेयाः स्यात्तरणिाकरणीयं सम्बन्ध
जन्यतावच्छेदकं यद्विद्वत्तैजात्ययं कल्पामिति न अभिचार इति वाच्यम् ।
तज्जन्यतावच्छेदकवैजात्ययकल्पनामपेक्ष्य तत्तत्सम्बन्धानां एकशक्तिसत्त्वेन
कारणकल्पनाया एव लघुत्वेन व्याख्याता इत्याहुः । तत्र ।... अन्यतमत्वेन
कारणतासम्भवात्..... परं तु तद्व्यादिस्मन्मन्त्राख्यानवायुसंधीगादीनां एक-
शक्तिसत्त्वेन हेतुतामादाय विनिगमनाविरहात् न शक्तिसिद्धिः इत्याहुः ।
Sloka 2, cf. also, तद्व्यादिस्मन्मन्त्राख्यानवायुसंधीगादीनां एक-
शक्तिसत्त्वेन हेतुतामादाय विनिगमनाविरहात् न शक्तिसिद्धिः इत्याहुः ।

Cf. Udayana, Kusumánjali, Stavaka 1— कर्तृ रहिं
तद्व्यादिस्मन्मन्त्राख्यानवायुसंधीगादीनां एक-
शक्तिसत्त्वेन हेतुतामादाय विनिगमनाविरहात् न शक्तिसिद्धिः इत्याहुः ।
यदि हि विजातीयेषु अपि एकजातीयकार्यकारण-शक्तिः
समवेद्यात्, न कार्यात् कारणविशेषः कश्चित् अनुमीयेत । कारणव्याख्याया च
न तज्जातीयस्यैव कार्यस्य व्याहरितवसीयेत ।..... एतेन सूक्ष्मातीत्यमिति
निरस्तम् । अवज्ञेरपि तत्सूक्ष्मात् सूक्ष्मीतपञ्चापत्तेः ।

The Scientific Methods already noticed, the
Joint Method of Difference (the Panchakārani),
and the Joint Method of Agreement (Vyáptigraha
with Upádhisanká-nirāsa and Tarka), are not the
only methods of ascertaining causality or concomi-
tance, or establishing a theory (सिद्धान्त); nor are these
Methods always practicable. Very often, we reach
the explanation of a fact (उपपत्ति) by means of a
Hypothesis (कल्पना) properly tested and verified
(निर्णयित). A legitimate Hypothesis must satisfy the
following condition :—(1) the hypothesis must
explain the facts (दृष्टसिद्धि, or उपपत्ति ; (2) the

hypothesis must not be in conflict with any observed facts or established generalisations (दृष्टसिद्धये हि बह्वृत् कल्पाने, न दृष्टविधाताय—Jayanta, Nyāya-Manjari, A'hnika 1); (3) no unobserved agent must be assumed, where it is possible to explain the facts satisfactorily by observed agencies (यदि बह्वृत्समकारण दृष्टं न सिद्ध्यति काममदृष्टं कल्पयाम, अन्यथाऽपि तदुपपत्तौ किं तदुपकल्पनेन, *ibid*); (4) when two rival hypotheses are in the field, a crucial fact or test (विनिगमक, *ratio sufficiens*) is necessary; the absence of such a test (विनिगमनाविरह) is fatal to the establishment of either, (5) of two rival hypotheses, the simpler, *i.e.*, that which assumes less, is to be preferred (*ceteris paribus*) (कल्पनाल्पाद्य *versus* कल्पनागौरव); (6) of two rival hypotheses, that which is immediate or relevant to the subject-matter is to be preferred to that which is alien or remote (प्रत्यक्षोपस्थिततल); (7) a hypothesis that satisfies the above conditions must be capable of *verification* (निर्णय) before it can be established as a theory (सिद्धान्त). The process of verification of a hypothesis consists in showing that it can be deduced as a corollary from (or is involved by implication in some more general proposition which is already well-established (cf. Vatsyayana's exposition and illustration of Verification, निर्णय—including both the Deductive Method and Colligation).

This doctrine of Scientific Method, in Hindu Logic, is only a subsidiary discipline, being com-

prehended under the wider conception of Methodology, which aims at the ascertainment of Truth whether scientific (Vijnana) or philosophical (Jnana) (मीचे धीर्ज्ञानम् सात् विज्ञानं द्वित्वज्ञात्तयोः, Amara-Kosha);—the latter being the ulterior aim. In the investigation of any subject, Hindu Methodology adopts the following procedure. (1) the proposition (or enumeration) of the subject-matter (Uddesa), (2) the ascertainment of the essential characters or marks, by Perception, Inference, the Inductive Methods, etc.,—resulting in definitions (by लक्षण) or descriptions (by उपलक्षण); and (3) Examination and Verification (परीक्षा and निर्णय). Ordinarily the first step, Uddesa, is held to include not mere Enumeration of topics, but Classification or Division proper (विभागः उद्देशरूपानपायास्तु उद्देश एवासीत्। सामान्यसंज्ञया कीर्तनमुद्देशः प्रकारभेदसंज्ञया कीर्तनं विभाग इति—Jayanta, Manjari); but a few recognise the latter as a separate procedure coming after Definition or Description. Any truth established by this three-fold (or four-fold) procedure is called a Siddhānta (an established theory). Now the various Pramānas Proofs, i.e., sources of valid knowledge) in Hindu Logic. viz., Perception, Inference, Testimony, Mathematical Reasoning (सम्भव including Probability in one view) are only operations subsidiary to the ascertainment of Truth (तत्त्वनिर्णय). And the Scientific Methods are merely ancillary to these Pramānas themselves.

I have explained the principles of the Hindu doctrine of Scientific Method, avoiding the technicalities of Logic as far as possible; and I cannot here enter upon the logical terminology or the logical apparatus and machinery, which would require a separate volume to themselves. For these, I would refer the reader to my paper on Hindu Logic,—as also for an account of the later Nyāya (न्याय), which, in spite of its arid dialectics, possesses a three-fold significance in the history of thought: (1) logical, in its conceptions of Avachchhedaka and Pratiyogi, being an attempt to introduce quantification on a connotative basis, in other words, to introduce quantitative notions of Universal and Particular, in both an affirmative and a negative aspect, into the Hindu theory of Inference and Proposition regarded connotatively as the establishment of relation among attributes or marks; (2) scientific, in its investigation of the varieties of Vyāpti and Upādhi, (and of *चर्यासिद्ध*) being an elaboration of Scientific Method, in the attempt to eliminate the irrelevant; and (3) ontological and epistemological, in its classification and precise determinations of the various relations of Knowledge and Being, with even greater rigidity and minuteness than in Hegel's Logic of Being and Essence. I will conclude with a few observations on Applied Logic, i.e., the logic of the special sciences, which is such a

characteristic feature of Hindu scientific investigation. What is characteristic of the Hindu scientific mind is that without being content with the general concepts of Science and a general Methodology, it elaborated the fundamental categories and concepts of such of the special sciences as it cultivated with assiduity, and systematically adapted the general principles of Scientific Method to the requirements of the subject-matter in each case. The most signal example of applied logic (or Scientific Method) worked out with systematic carefulness is the Logic of Therapeutics in Charaka, a Logic which adapts the general concepts of cause, effect, energy, operation, etc., and the general methodology of science to the special problems presented in the study of disease, their causes, symptoms and remedies (*vide* Charaka, Vimánasthána, Chap IV,—also Sutra Sthána, — *vide* my Paper on Hindu Logic). Here I will give an illustration of Applied Methodology from the Science of Analytical and Descriptive Grammar. Patanjali, in the Mahá-bhāshya, (Circa 150 B. C.) is very careful as regards Methodology. I take no note now of the philosophical presuppositions of his philology (*vide* my Paper on the Hindu Science of Language), but will confine myself to his presentation of the Applied Logic of Descriptive and Analytical Grammar. The sentence is the unit of speech, as every Hindu philologist contends, but the first business of Analytica

Grammar is to analyse the sentence into its significant parts and their coherent relations to one another. Assuming that articulate sounds are significant, the question is.—how is the sentence, which is the unit of articulate speech, broken up into significant words and their mutual relations? Pātanjali answers that this is done by an instinctive use (cf. Vāchaspati's भूयै दर्शनजनितसंस्कारम् इन्द्रियम्) of the Joint Method of Difference (combined Addition and Subtraction), fortified by the Joint Method of Agreement (बन्धव्यतिरेकौ). Pātanjali starts with a simple case. Take the two sentence-units :—Pathati (he reads) and Pachati (he cooks). Suppose you start with the assumption that these sounds are significant, and *that separate elements have separate meanings*. Then you hear Pathati, and, at the same time, a man reading is pointed at. Then the assemblage of sounds Pathati (i. e., Path+ati) stands for the assemblage—'one reads,' (i. e. the action reading+an individual agent). Similarly by finger-pointing or other indication, you find that the assemblage Pachati i. e., Pach+ati) stands for the assemblage 'one cook's (i. e. the action cooking +an individual agent, say, the same agent as before).

Now look at the grouping :—

Path + ati = reading + one agent.

Pach + ati = cooking + one agent.

From repeated observation of similar groupings, one is led to conclude that path is the invariable concomitant of the action 'reading', because the disappearance of the formar (the other element remaining) leads to the disappearance of the latter (a rough Method of Difference by subtraction—होयते); that Pach is the invariable concomitant of the action 'cooking' because the introduction of Pach (with nothing else added) leads to the introduction of the action 'cooking,' (a rough Method of Difference by addition,—उपजायते); and that Ati, which is the only 'common antecedent' (अन्वयी). is the invariable concomitant of 'one agent' which is the only common 'consequent' (अन्वयी). In fact, the last should come first by the Method of Agreement, then the other two either by Residue, or by Joint Agreement in presence and absence (अन्यव्यतिरेकी). So far all is plain sailing, though only very simple and very rough applications of the Methods are given. But—and this is the point—throughout the argument, it is assumed that one sound is the concomitant of one idea, in other words, there is no plurality of causes to vitiate the application of the Method of Agreement in the above example. And now the objection is advanced that this basal assumption is untrue. The same sound is not the concomitant of the same idea. Different words (sounds) may have the same meaning, and the same word (sound) may have

different meanings. We cannot therefore by the Joint Method of Agreement (अन्वयव्यतिरेकी) determine the meanings of words, or the separate functions of roots (stems) and inflections,—at least not so simply as is pretended above. Patanjali states this difficulty in the way of applying the Scientific Methods to the problems presented by Analytical Grammar, a difficulty arising from the plurality of causes, but does not state the solution. The solution, however, depends on the Method of subtraction and addition (Patanjali's वीचते and उपनायने). For it will be found by extensive observation that the number of meanings of which a word (sound) may be capable is limited. So also is the number of words (sounds) expressive of a given meaning. Hence, by the Method of Difference, etc., the causal relations of words and meanings may be determined. Patanjali thus established the doctrine of Prakriti and Pratyaya (roots and inflections), with their separate significance, which is of course a necessary postulate in the case of an inflectional language like Sanskrit. Isolating and Agglutinative languages offer less difficulty, whereas the difficulties are in some respects enhanced in the case of languages with a polysynthetic or incorporating (incapsulating) morphological structure.

कथं पुनर्ज्ञायते अयं प्रत्ययार्थः अयं प्रत्ययार्थ इति । अन्वयव्यतिरेकाभ्याम् ।
कोऽसौ अन्वयो व्यतिरेकी वा । इह पञ्चतन्त्रे कश्चित् शब्दः श्रूयते,

पठतीत्युक्ते कश्चित् शब्दो होयते (पठ्),—कश्चित् उपजायते (पठ्),—
कश्चित् अन्वयी (चति);—चर्योऽपि कश्चित् होयते (विक्रिति:),—
कश्चित् उपजायते (पठिक्रिया),—कश्चित् अन्वयी (कर्तृत्वं चैकत्वं च) ।
तेन मन्यामहे यः शब्दो होयते, तस्य असौ अर्थः योऽर्थो होयते । यः शब्द
उपजायते तस्य असौ अर्थः योऽर्थे उपजायते । यः शब्दोऽन्वयी तस्य असौ
अर्थः योऽर्थोऽन्वयी ।

विषम उपन्यासः—वह्नवो हि शब्दा एकार्था भवन्ति । तदयथा इन्द्रः
शक्रः पुरन्दरः । एकश्च शब्दो वह्नर्थः । तदयथा यथाः पादा भाषा इति ।
अथ किं न साधोषोऽर्थवत्ता सिद्धा भवति । नापि ब्रूमोऽर्थवत्ता न
सिध्यतीति । चरिता हि अर्थवत्ता अन्वयव्यतिरेकाभ्यामेव । तत्र कुत
एतदयं प्रकृत्यर्थः अयं प्रत्ययार्थ इति । (Mahābhāṣya, 1—3, 9,)

Patanjali not only applies the Scientific Methods to the foundations of Grammatical Analysis, but also *by their means* establishes and elaborates the fundamental categories and concepts of Grammatical (and Philological) Science, *e. g.*, the concepts of action (क्रिया), agent (कर्ता), instrumental cause (करण साधकतमम्), end (निमित्त), origin (हेतु) limit (अवधि) substance (द्रव्य), quality (गुण), and genus (जाति); —also of the fundamental relations (at the bottom of all thought and *speech*)—the relations of Time (कालवृत्तसम्बन्ध), of space (दिग्दिग्गसम्बन्ध), of causality (कार्यकारणभाव), of inherence (समवाय), of co-inherence (सामायाधिकरण्य), of substance and attribute (विशिष्टावशिष्टभाव), of the sign and the signate (संज्ञासंज्ञिभाव), of mutual dependence (इतरैतराश्रय); —an entire grammatical (and philological) apparatus, which will serve as a *point d'appui* for generations of philologists and grammarians to come.

ADDENDA.

(BY PRINCIPAL BRAJENDRANATH SEAL.)

Empirical Recipes from Varahamihira (circa 550 A.D.) relating to Chemical Technology.

A. Searing of hard rocks to enable them to be cut (or pulverised) (शिलादारण).

Sprinkle on the rock taken red-hot from the fire of Palasa and Tinduka wood (*Butea Frondosa* and *Diospyros Embryopteris*) :—(a) diluted milk, or (b) a solution of wood ashes (the ashes of the *Mokshaka* mixed with those of reeds), or (c) a decoction of (the fruit) of the jujube (*Zizyphus Jujuba*) kept standing for 7 nights in a mixture of whey, vinegar and spirits, in which *Kulattha* (*Dolichos Uniflorus* or *Biflorus*) has been steeped, or (d) a solution of the ashes of the *Neema* bark and leaves (*Azadirachta Indica*), the sesame pod, the resinous fruit of the *Diospyros Embryopteris*, and the *Guduchi* (*Tinospora Cordifolia*) with cow's urine. Repeat the process seven times (in the last case six times).

(Varāhamihira, *Vrihat-sanhitā*, Chap. 33,
Slokas 112-117).

B. Hardening of steel (*ग्रस्त्रपान*).

(1) Plunge the steel red-hot into a solution of plantain-ashes in whey, kept standing for 24 hours ; then sharpen on the lathe.

(2) Make a paste with the juice of the Arka (*Calotropis Gigantea*), the gelatine from the horn of the sheep, and the dung of the pigeon and the mouse ; apply it to the steel after rubbing the latter well with (sesame) oil. Plunge the steel, thus treated, into fire ; and when it is red-hot, sprinkle on it water, or the milk of the horse (or the camel or the goat), or ghee (clarified butter), or blood, or fat or bile. Then, sharpen on the lathe.

(Varāhamihira, *सूक्तसंख्यम्*,
chap. 49, slokas 23-26.

C. Preparation of cements (for rocks, metals, etc.) (*वस्तुलेप*)—

Varāhamihira gives the following recipes among others. (1) First, prepare a levigated powder with lac, the resinous exudation of the *Pinus Devadara*, the *Balsamodendron Mukal*, the *Feronia Elephantum*, the kernel of the fruit of the *Ægle Marmelos* (the *bel*), the *Diospyros Embryopteris*, the *Neem* (*Azadirachta Indica*), the *Mhow* (*Bassia Latifolia*), the Indian madder (*Rubia Manjistha*), the *Phyllanthus Emblica*, and the resin of the Sala tree (*Shorea Robusta*), then make a decoction of this in 256 Palas of water reduced

by boiling to 32 Palas, and apply the decoction hot.

(2) The horns of cows, buffalos and goats, asses' hair, buffalo's skin, with *gavya* (cow's urine etc.), the Neem (*Azadirachta Indica*) and the *Feronia Elephantum*, similarly treated.

(3) A mixture of eight parts of lead, two of 'bell-metal' and one of brass, melted and poured hot (Maya's cement).

The first, it will be seen, has lac, gum and turpentine as principal ingredients, the second makes use of gelatine, and the third is a metallic cement.

D. Nourishment of Plants :—(from Varāhamihira, Chap. 54, on इच्छावृद्धि).

The most suitable ground to plant in is soft soil that has been sown with the *Sesamum Indicum*, and dug up or trodden over with the sesame in flower. Grafts should be smeared with cowdung. For transplanting, the plants should be smeared with ghee (clarified butter), sesame oil, the honey of the *Kshudra* variety of the bee, the oil of the *Usira* (*Andropogon Laniger* or *Andropogon Citrarum*), the *Vidanga* (*Embelia Ribes*), milk and cowdung. Trees should be planted at intervals of 20 or 16 cubits.

As a sort of general prophylactic, mud kneaded with ghee (clarified butter) and *Vidanga*, (*Embelia Ribes*) should be applied to the roots, after which

milk diluted with water should be poured. As a remedy against barrenness, a hot decoction should be made of Kulattha (*Dolichos Uniflorus* or *Biflorus*), Masha (*Phaseolus Roxburghii*), Mudga (*Phaseolus Mungo*), Tila (*Sesamum Indicum*), and Yava (barley); which, when cooled, should be poured round the roots.

To promote inflorescence and fructification, a mixture of one A'dhaka (64 palas) of sesame, two A'dhakas (128 palas) of the excreta of a goat or sheep, one Prastha (16 palas) of barley powder, one Tula (100 palas) of beef, thrown into one Drona (256 palas) of water, and standing over for seven nights, should be poured round the roots of the plant. The measures given are for one plant.

To ensure inflorescence, etc., the seed before being sown should be treated as follows:—The seeds should be taken up in the palm greased with ghee (clarified butter), and thrown into milk;—on the day following, the seeds should be taken out of the milk with greased fingers, and the mass separated into single seeds. This process is to be repeated on ten successive days. Then the seeds are to be carefully rubbed with cowdung, and afterwards steamed in a vessel containing the flesh of hogs or deer. Then the seeds are to be sown with the flesh, with the fat of hogs added, in a soil previously prepared by being sown with sesame and dug up or trodden down.

To ensure the formation of *Ballaris* (i.e., sprouting and the growth of luxuriant stems and foliage), the seeds should be properly soaked in an infusion of powdered paddy, *Masha* (bean), sesame and barley mixed with decomposing flesh, and then steamed with *Haridra* (turmeric). This process will succeed even with the *Tintidí* (*Tamarindus Indica*). For the *Kapittba* (*Feronia Elephantum*), the seeds should be soaked for about two minutes (lit. such length of time as it would take one to make a hundred rhythmic claps with the palms *हालशब्द* in a decoction of eight roots (*A'sphota*, *A'malakí*, *Dhava*, *Vásika*, *Vetasa*, *Suryyavalli*, *Syáma* and *Atimukta*, i.e., the Jasmine, the myrobalan, the *Grislea Tomentosa*, the *Justicia Ganderussa*, the *Calamus Rotang*, the *Gymandropsis Pentaphylla*, the *Echites Frutescens*, and the *Dalbergia Oujeinensis*) boiled in milk. The seeds should then be dried in the sun. This process should be repeated for thirty days. A circular hole should be dug in the ground, a cubit in diameter and two cubits deep, and this should be filled with the milky decoction. When the hole dries up, it should be burnt with fire, and then pasted over with ashes mixed with ghee and honey. Three inches of soil should now be thrown in, then the powder of bean, sesame and barley, then again three inches of soil. Finally, washings of fish should be sprinkled, and the mud

should be beaten and reduced to a thick consistency, then the seed previously prepared should be placed in the hole under three inches of soil, and fish-washings poured. This will lead to luxuriant ramification and foliage, which will excite wonder. The Agnipurāna adds that the mango is specially benefited by cold fish-washings (मत्स्योदकेन प्रोतेन चाद्यादां सृज इत्यने—इत्यायुर्वेद, Agnipurāna). It will be seen that these elaborate recipes are empirical contrivances for supplying the requisite nitrogen compounds, phosphates and bacteria, these being potentially contained in the mixtures and infusions prescribed.

SANSKRIT TEXTS.

Extracts from RASARATNAKARA.

नागार्जुन-विरचितात्

रसरत्नाकरादुद्धृताः श्लोकाः ।

अथ महारसशोधनं व्याख्यास्यामः ।

किमत्र चित्रं यदि राजवत्सेकं

शिरीषपुष्पाग्रसेन भावितम् ।

सितं सुवर्णं तरुणाकंसन्निभं

करोति गुञ्जाशतमेकगुञ्जया ॥ १ ॥

राजावत्सेशोधनम् ।

किमत्र चित्रं यदि पीतगन्धकः

पलाशनिर्व्यासरसेन शोधितः ।

आरण्यकैरुत्पलकैस्तु पाचितः

करोति तारं त्रिपुटेन काञ्चनम् ॥ २ ॥

गन्धकशुद्धिः ।

किमत्र चित्रं रसको रसेन

• • • • ।

क्रमेण कृत्वाऽभ्युधरेण रञ्जितः

करोति शुक्लं त्रिपुटेन काञ्चनम् ॥ ३ ॥ *

रसकशोधनम् ।

किमत्र चित्रं दरदः सुभावितः

पयेन[†] मेष्ट्या बहुशोऽस्त्रवर्गः ।

सितं सुवर्णं बहुधर्मभावितं

करोति साक्षाद्वरकुङ्कुमप्रभम् ॥ ४ ॥

दरदशुद्धिः ।

कुलत्थकोद्रवक्वाथे नरमूत्रेण पाचयेत् ।

वेतसाद्यस्त्रवर्गेण दत्त्वा चारं पुटत्रयम् ॥ ५ ॥

किमत्र चित्रं कदलीरसेन

सुपाचितं सूरणकन्दसंस्थम् ।

* Agrees nearly with Rasārnava ; cf. Vol. I. Sans. Texts, p. 13.

† पयसा is the correct form.

वातारितैलेन घृतेन ताप्यं

पुटेन दग्धं वरशुद्धिमेति ॥ ६ ॥

माक्षिकशोधनम् ।

डिगुणा विमला पथ्या रश्मातोयेन संयुता ।

लवणैर्वर्क^{*}दुग्धेन ताम्रपत्राणि लेपयेत् ॥ ८ ॥

अग्नौ सन्तप्य निर्गुण्डीरससिक्तानि सप्तधा ।

मासान् वसुरसेनैव शुल्वशुद्धिर्भविष्यति ॥ १० ॥

परतः सर्व्वलोद्धशोधनम् ।

अस्त्रवेतसधान्यास्त्रमेघौतोयेन शुध्यति ॥ ११ ॥

विमलशुद्धिः ।

चपलाद्या धातवः सर्व्वे जम्बोररसभाविताः ।

शोधितास्त्रिदिनं पञ्चसृत्तिकाभस्मलावणैः ।

संयुताः संशोधयन्ति पुटपाकेन काञ्चनम् ॥ १२ ॥

हेमशोधनम् ।

नागेन क्षारराजेन ध्रापितं शुद्धिसृच्छति[†] ।

* The text reads वर्क, which is incorrect.

† This verse also occurs in Rasārṇava.

तारं त्रिवारनिक्षिप्तं पिशाचीतैलमध्यगम् ॥१३॥

तारशुद्धिः ।

अहो नु चित्रं पृथिवीभवेन

चारिण मेघीपयसा हृतेन ।

तैलेन शुद्धं द्रुतघोडशांशं

भवेच्च शुद्धं शशिशृङ्गसन्निभम् ॥१४॥

मोक्षमारीटपालाश-चारगोमूत्रभावितम् ।

वज्रकन्दशिखाकल्क-फलमूलसमन्वितम् ॥१५॥

तत्कल्कं कण्टकं साक्षाच्चूर्णं वैक्रान्तसम्भवम् ।

सारधेय* समायुक्तं मेषशृङ्गीद्रवान्वितम् ॥१६॥

पिण्डितं मूकमृषास्थं धामितञ्च हठाग्निना ।

तत्रैव पतते सत्त्वं वैक्रान्तस्य न संशयः ॥१७॥

वैक्रान्तसत्त्वम् ।

चौद्रं गन्धर्व्वतैलं सष्टतमभिनयं

गो रसं मूत्रकञ्च

* These couplets also occur in R. R. S., with this difference that in the latter मयसार has been substituted for सारधेय.

भूयो वातारितैलं कदलिरसयुतं

भावितं कान्तितप्तम् ।

मूषां कृत्वाग्निवर्णामरुणकरनिभां

प्रक्षिपेन्माक्षिकेन्द्रं

सत्त्वं नागेन्द्रतुल्यं पतति च सहसा

सूर्यवैश्वानराभम् ॥ २५ ॥ *

महावृक्षार्कचोराभ्यां स्त्रीस्तन्येन सुभावितम् ।

मूषायामग्निवर्णायां द्रवेत्ताप्यं न संशयः ॥ २६ ॥

कङ्कुष्ठटङ्गुणाभ्याञ्च ताप्यं स्त्रीस्तन्यमर्हितम् ।

पश्चात्सत्त्वं निपतति सत्यं मूषा तु अग्निवत् ॥ २७ ॥

कार्क्षिकं बहुशस्त्रिणं ताप्यचूर्णं कटुविकम् ।

कृत्वाम्बुमधुभ्यां पक्वं वज्रपायसभावितम् ॥ २८ ॥

गृहधूमं घृतं चोद्रे संयुतं पुनरेव च ।

धामितं मूकमूषायां शशिशुल्बनिभं भवेत् ॥ २९ ॥

कदलीरसशतभावितं घृतमध्येरण्डतैलपरिपक्वम् ।

ताप्यं मुञ्चति सत्त्वं रसकक्षैव त्रिसङ्घाते ॥ ३० ॥

माक्षिकसत्त्वपातनविधिः ।

* Cf. Rasārṇava, Vide Sans. Texts, Vol. I., p. 12

चारस्नेहैव धान्यास्त्रे रसकं भावितं बहु ।
 ऊर्णा लाक्षा तथा पथ्या भूलता धूमसंयुतम् ॥ ३१ ॥
 मूकमूषागतं धातं टङ्गणेन समन्वितम् ।
 सत्त्वं कुटिलसङ्काशं पतते नात्र संशयः ॥ ३२ ॥ *

रसकसत्त्वम् ।

विमलं शिग्रतोयेन काक्षीकासौसटङ्गणैः ।
 वज्रकन्दसमायुक्तं भावितं कदलीरसैः ॥ ३५ ॥
 माक्षीकचारसंयुक्तं धामितं मूकमूषके ।
 सत्त्वं चन्द्रार्कसङ्काशं पतते नात्र संशयः ॥ ३६ ॥†

विमलसत्त्वम् ।

दरदं पातनायन्त्रे पातितञ्च जलाशये ।
 सत्त्वं सूतकसङ्काशं जायते नात्र संशयः ॥ ३७ ॥
 दरदसत्त्वम् ।

गन्धकञ्च प्रभावेण सत्त्वभूयं खभावतः ।

* Cf. Rasārṇava, Benares MS. V. 37—38.

† Cf. Sans. Texts, Vol. I. p. 12. R. R. S. Bk. ii, 103—104.

ततः ख्यातं महासत्त्वं रसेन्द्रस्य समं ततः ॥ ३८ ॥

अभ्रकादिसत्त्वपातनविधिः ।

एक एव महाद्रावौ पार्व्वतीनाथसम्भवः ।

किं पुनस्त्रिभिः संयुक्तौ वेतसान्नास्त्रकाञ्चिकैः ॥ ५० ॥

मुष्काफलानि सप्ताहं वेतसान्नेन भावयेत् ।

पुटपाके ततश्चूर्णं द्रवते सन्निलं यथा ।

कुरुते योगराजोयं रत्नानां द्रावणे परम् ॥ ५१ ॥

अभ्रकादिद्रुतपातनविधिः ।

तालेन वङ्गं दरदेद तीक्ष्णं

नागेन हेमं शिलया च नागम् ।

गन्धाश्मना चैव निहन्ति शुल्बं

तारञ्च मात्तीकरसेन हन्यात् ॥ ५२ ॥

शुल्बम् अजाक्षीरसुगन्धकेन

तारं सुहीक्षीरसुमाक्षिकेण ।

यद्यस्य धातोर्विहितञ्च युक्तं

निरत्यघातं कथितञ्च तीक्ष्णैः ॥ ५४ ॥

मृतानि लोहानि रसोभवन्ति
 रसेन युक्त्यामयनाशनानि ।
 अभ्यासयुक्ता पलितादिनाशं
 कुर्वन्ति तेषाञ्च जराविनाशम् ॥ ५५ ॥

इति नागार्जुनविरचिते रसरत्नाकरे वज्रमारण-
 सत्त्वपातन-अभ्रकादिद्रावण-वज्रलोह-
 मारणाधिकारो नाम द्वितीयः ।

अथातो रसबन्धाधिकारं व्याख्यास्यामः ।

जम्बीरजेन नवसारधनास्त्वगैः
 क्षाराणि पञ्च लवणानि कटुत्रयञ्च ।
 शिग्रूदकं सुरभिस्सूरणकन्द एभिस्-
 संमर्दितो रसनृपश्चरतेऽष्टलोहान् ॥ १ ॥

चारणजारणविधिः ।

• • • • •

प्रज्ञापारमिता निशीथसमये स्वप्ने प्रसादीकृतं
 नाम्ना तीक्ष्णमुखं रसेन्द्रममलं नागार्जुनप्रोदितम् ॥ ४ ॥

• • • • •

रसं हेमसमं मर्द्यं पीठिकागिरिगन्धकम् ।
 द्विपदीरजनीरम्भां मर्दयेत् टङ्कणान्विताम् ॥३०॥
 नष्टपिष्टञ्च सुष्कञ्च अन्धमूर्था निधापयेत् ।
 तुषाक्षघृण्टं दत्त्वा यावद्भस्मत्वमागतः ॥३१॥
 भक्षणात्साधकेन्द्रसु दिव्यदेहमवाप्नुयात् ॥३२॥

.

गर्भयन्त्रं प्रवक्ष्यामि पीठिकाभस्मकारकम् ।
 चतुरंगुलदोर्वेण विस्तारेण च त्राङ्गलाम् ॥३२॥
 मूषां तु सन्मयीं कृत्वा सुदृढां वर्त्तलां बुधः ।
 विंशभागन्तु लोहस्य भागमेकं तु गुग्गुलोः । ॥३३॥
 सुश्लक्ष्णं पेषयित्वा तु तोयं दत्त्वा पुनः पुनः ।
 मूषालेपं दृढं बद्धा लोणार्द्धमृत्तिका बुधः ॥३४॥
 कषे तुषाग्निना भूमौ मृदुस्त्रेदेन स्त्रेदयेत् ॥३५॥
 सूतकस्य पलं गृह्यं तुर्यांशं सात्त्विकं विषम् ।
 तत्समं गन्धकं शुक्लं चूर्णं कृत्वा विनिक्षिपेत् ॥३६॥
 कृत्वा कज्जलिकामादौ पलं दत्त्वा च गन्धकम् ।
 घृतपक्वञ्च तच्चूर्णं पचेदायसभाजने ॥३७॥

यावद्वत्त्वमायाति तत्त्वणात् तं विनिचिपेत् ।
 पुटे वा कदलीपत्रे सिद्धं पर्पटकारसम् ॥८६॥
 द्वितीयपर्पटोरसः ।

प्रणिपत्य सर्व्वबुद्धान्
 (सद्बोधान्) सकलदोषनिर्मुक्तान् ।

वक्ष्ये सर्व्वहितायै

कचापुटं सर्व्वसिद्धिकारम् ॥

श्रीशैलपर्व्वतस्थायो सिद्धो नागार्जुनो महान् ।

सर्व्वसत्त्वोपकारी च सर्व्वभाग्यसमन्वितः ॥

प्रार्थितो ददते शौघं यच्च पश्यति यादृशम् ।

दृष्ट्वा त्वागञ्च भोगञ्च सूतकस्य प्रसादतः ।

सर्व्वसत्त्वामयावेधो स्वरसेन तथैव च ॥

तेषां मध्ये प्रधानञ्च रत्नघोषः प्रचारकः ।

कृताञ्जलिपुटो भूत्वा नागार्जुनपुरः स्थितः ।

पृच्छते रसकर्माणि विद्यादानं ददस्व मे ॥

श्रीनागार्जुन उवाच—

साधु साधु महाप्राज्ञ तुष्टोऽहं भक्तवत्सलः ।

कथयामि न सन्देहस्तत्त्वया परिपृच्छ्यताम् ॥

वलीपलितनाशञ्च तथा कालस्य ध्वंसनम् ।
यथा लोहे तथा देहे क्षमते नात्र संशयः ॥

* * * *

सत्त्वानां भोजनार्थाय साधिता वटयक्षिणी ।
द्वादशानि च वर्षाणि महाक्लेशः कृतो मया ॥
तत्कालदृष्टद्रव्याणां दिव्या वाणी मया श्रुता ।
अदृष्टप्रार्थिता पद्यादृष्टा त्वं भव साम्प्रतम् ॥

श्रीवटयक्षिण्युवाच—

साधु साधु महासिद्ध * * *
किञ्चिन्नार्थय मे सिद्ध तत्सर्वं प्रददाम्यहम् ॥

श्रीनागार्जुन उवाच—

यदि तुष्टासि मे देवि सर्व्वदा भक्तिवत्सले ।
दुर्लभं त्रिषु लोकेषु रसवन्धं ददस्व मे ॥

शालिवाहन उवाच—

सुवर्णरत्नभाण्डारं कुमारी मदसुन्दरी ।
निवेदितो मयात्मा मे आदेशो देवि दीयताम् ॥
साधु साधु महाप्राज्ञ ममादेशप्रपालक ।
साधयामि न सन्देहो युष्मत्सत्त्वेन साधकम् ॥

पुनरन्यं प्रवक्ष्यामि माण्डव्येन यथा कृतम् ।
 रसोपरसयोगिन सिद्धं सूतं सुसाधितम् ॥
 विडशुल्वायनं नागं यथार्थकाञ्चनं कृतम् ।

* * * *

शास्त्रं वशिष्ठमाण्डव्यं गुरुपार्श्वं यथा श्रुतम् ।
 तदहं सम्प्रवक्ष्यामि साधनञ्च यथाविधि ॥
 सहायशोभनाः प्राज्ञा निरालम्बा दृढव्रताः ।
 कुलीनाः पापहीनाश्च साधयन्ति जितेन्द्रियाः ॥
 कोष्ठिका वक्रनालश्च गोमयं सारमिश्रणम् ।
 धमनं लोहपत्राणि श्रौषधं काष्ठीकं विडम् ॥
 कन्दराणि विचित्राणि * * *
 सर्वमेलयनं कृत्वा ततः कर्म समारभेत् ॥

रत्नघोष उवाच—

साधयित्वा प्रयत्नेन कोटिविधौ महारसः ।
 शरीरेण विनैतेन सर्वं भवति निष्फलम् ॥

नागार्जुन उवाच—

कथयामि न सन्देहः साकाण्डेन यथा कृतम् ॥
 आर्द्रत्वञ्च घनत्वञ्च चापत्न्यं गुरुतेजसः ।

यस्यैतानि न दृश्यन्ते तं विद्याद्गुरुसूतकम् ॥
 नानावर्णं भवेत्सूतं विहाय घनचापलम् ।
 लक्षणं दृश्यते यस्य मूर्च्छितं तं वदन्ति हि ॥
 गुरुत्वमरुणत्वं वा तेजो भास्करसन्निभम् ।
 अग्निमध्ये यदा तिष्ठेत् खोटवन्धस्य लक्षणम् ॥*

अथातो रसेन्द्रमङ्गलानि यन्त्रविधिः ।

शिलायन्त्रं, पाषाणयन्त्रं, भूधरयन्त्रं, वंशयन्त्रं,
 नलिकायन्त्रं, गजदन्तयन्त्रं, दोलायन्त्रं, अधःपातन-
 यन्त्रं, भुवःपातनयन्त्रं, पातनयन्त्रं, नियामकयन्त्रं,
 गमन(?)यन्त्रं, तुलायन्त्रं, कच्छपयन्त्रं, चाकीयन्त्रं,
 वालुकायन्त्रं, अग्निसोमयन्त्रं, गन्धकवाहिकयन्त्रं,
 मूषायन्त्रं, हण्डिकायन्त्रं, कम(?)भाजनयन्त्रं घोणा-
 यन्त्रं, गुहाभ्रकयन्त्रं, नारायणयन्त्रं, जालिकायन्त्रं,
 चारणयन्त्रम् ।

अथ प्रवक्ष्ये सुगुरुपदेशान्

यः पाटलाख्यस्य रसस्य वृद्धः ।

* Cf. Rasárnava. Vide Sans. Text, Vol. I. pp. 17—18.

यस्य प्रभावात् क्षयमेहकृच्छ्र-
ज्वरादिकुष्ठामयनिग्रहः स्यात् ॥

निक्षिप्य खले त्रिपुरान्तकस्य
वोजं दिशुर्दार्ढ्यपलप्रमाणम् ।

क्वाथेन तस्य त्रिपुरोद्धवेन
सम्पदयेत् त्रिदिनानि यावत् ॥

कन्यारसेन त्रिदिनं ततश्च
सप्तार्चिषा चाथ दिनत्रयञ्च ।

चूर्णेस्त्रिकाया रजनोरजेन*
सम्पदितं तम् उपतोयधीतम् ॥

त्रौणि प्रमाणान्यथ सप्तमञ्च
सम्पातयेत् पातनयन्त्रयोगात् ।

सम्पातितो निर्मलतामुपैति
सर्व्वप्रयोज्योऽपि हितं प्रशस्तम् ॥

पलं समादाय रसस्य तस्य
शुक्लस्य शुद्धस्य च कर्षमेकम् ।

* The text seems to be incorrect.

लत्वाष्टपिष्टौ विधिवत्तैयोश्च
 गन्धाश्मचूर्णे द्विगुणश्च देयम् ॥
 छतप्रयोगेण विपाच्य पद्मान्-
 निक्षिप्य खल्ले परिमर्दितश्च ।
 निष्कश्च मात्रां त्वमृतस्य दत्त्वा
 गुञ्जाप्रमाणा गुटिका च कार्या ॥
 श्रीलोकनाथस्य विभोः प्रसादात्
 ज्ञातं मया पोटलिकाविधानम् ॥

• • • • •

इति रसेन्द्रमङ्गलं समाप्तम् ।

Extracts from RASAHRIDAYA.

भगवद्गोविन्दपादविरचितात्
रसहृदयादुद्धृताः श्लोकाः ।

A = MS. from Nepal.

B = MS. from India Office Library, with a commentary, named "Bālānvayabodhikā."

C = MS. from Benares.

द्वितीयपटलादुद्धृताः श्लोकाः ।

[टीका—मूर्च्छितरसस्य उत्थापनसंस्कारमाह—]

अमुना विरचनेन हि सुविशुद्धो नागवङ्गपरिमुक्तः ।

सूतः^१ पातनयन्त्रे समुत्थितः^२ काञ्चिके कायात्^३ ॥

[टीका—अथ मूर्च्छितरसस्य पञ्चमोद्दिष्टपातनसंस्कारं स्पष्टयन्माह—]

(1) A reads पात्र, which makes the sentence incomplete and the metre defective.

(2) A reads सुविशुद्धं, which is a tautology as well as a grammatical error.

(3) काञ्चिकेन कायात् is the variant in B. This is a defective metre.

कृत्वा तु शुल्बपिष्टीं¹ निपात्यते नागवङ्गशङ्कातः² ।
 तस्मिन् दोषान् मृक्का³ निपतति शुद्धस्तथा सूतः⁴ ॥
 अष्टाङ्गुलविस्तारं⁵ देर्घेण⁶ दशाङ्गुलं त्वधोभाण्डम् ।
 कण्ठादधः समुच्छ्रितचतुरङ्गुलकज्जलाधारम्⁷ ॥
 अन्तःप्रविष्टतलभाण्डं⁸ वदनजलमग्ननिजमुखप्रान्ता⁹ ।
 उपरिष्ठाच्चिपिटपटी¹⁰ देयोदरषोडशाङ्गुलविशाला ॥

(1) A reads सुलपिष्टिम्.

(2) निपात्यते नागवङ्ग सदोष is the reading in A, which is incorrect as well as defective metre.

(3) A reads सुल दाषास्यका.

(4) A reads शुद्ध, which is a tautology as well as a grammatical error.

(5) B reads अष्टाङ्गुलस्य विलोके, which destroys the metre.

(6) B reads देर्घेण तु, wherein तु is redundant.

(7) B reads सम तचतुरङ्गुलं कतजलधारा, which mars the metre.

(8) A reads अन्तःप्रविष्टतलभाण्डं, which is a defective metre.

(9) B reads प्रान्तः, which is grammatically incorrect.

(10) A has उपरिष्ठाच्चिपुटपुटित, which is senseless.

तस्मिन्नधोर्द्ध्वभाण्डे¹ निपातितः सकलदोषनिर्मुक्तः² ।
 सुतरां भवति रसेन्द्रो जीर्णग्रामोऽपि पात्योऽसौ³ ॥
 कृत्वाथ⁴ नष्टपिष्टं त्रिफलाशिखिशिग्रुराजिकापटुभिः ।
 संलेप्य चोर्द्ध्वभाण्डं दीप्तैरुपलैरधः पात्यः⁵ ॥
 अथवा दीपकायन्त्रे⁶ निपातितः सकलदोषनिर्मुक्तः ॥
 कच्छप्रयन्त्रान्तर्गत⁷ मृन्मयपीठस्य दीपिकासंख्यः ।
 यस्मिन्निपतति सूतः प्रोक्तः⁸ तद्दीपिकायन्त्रम् ॥

(1) A reads तस्मिन् धूर्द्ध्वभाण्डे, which is incorrect.

(2) निपातितसकलनिर्मुक्तः, an incomplete variant in A.

(3) A has an incorrect reading—ग्रामजीर्णपपात्यासौ.

(4) This verse and the next two are not found in B.

(5) A reads उपलैरधःप्राज्ञा, which has no sense.

(6) A has दीपनयन्त्रे.

(7) A reads कच्छप्रयन्त्रे अन्तर्गत, which is grammatically incorrect.

(8) The word तत् is not found in A, thus making the metre defective.

सप्तमः पटलः ।

[टीका—अथ विडविधानमारभ्यते—]

ग्रामं न मुञ्चति न वाञ्छति तच्च भूयः

काञ्चिद्गुणान्^१ भजति^२ नित्यमनुक्तमावात्^३ ।

यज्जीर्यते प्रचुरकेवलवर्द्धियोगात्

तस्माद्विडैर्मुनिविडैः सह^४ जारणा स्यात् ॥

[टीका—विडविधानमाह—]

सौवर्चलकटुकवयकाङ्क्षो^५ काशीसगन्ध केश विडैः ।

शिग्रो रसशतभाष्यैस्ताम्रदलान्यपि हि जारयति^६ ॥

[टीका—विडान्तरमाह—]

(1) A reads काञ्चिद्गुणान्, which is incorrect.

(2) B reads व्रजति.

(3) अनुक्तविमुक्तमावात् is the variant in A,

(4) A reads मुनियतैरिमु, which seems to be incorrect.

मुनिविडैः means by seven विडs, mentioned below.

(5) A reads काञ्जि, which is incorrect.

(6) A has शिग्रुरसशतभावितम् । मस्य दनास्यपि हि जारयति, which is incorrect as well as defective in metre.

सर्व्वाङ्गदग्धमूलकप्रतिगलितं सुरभिर्मूत्रेण¹ ।

शतभाण्डं बलिवसया² तत्क्षणतो जाय्यते हेम ॥

[टीका—अथ चारवृक्षगुल्मीषधीराह—]

कदलीपलाशतिल³ निन्दलकनकसुरदालिवास्तुकैरण्याः ।

वर्षाभूवृषमोक्षक⁴ सहिताः चारा यथालाभम् ॥

[टीका—चारविधानमाह—]

पानीय चारवृक्षान् कुसुमफलशिफा-

त्वक्पलाशैरुपेतान्⁵

कृत्वातः खण्ड्यस्तान्⁶ विपुलतरशिला-

पिष्टपात्रातिशुष्कान्⁷ ।

(1) सर्व्वाङ्गं दग्धमूलकं रसप्रतिप्रतिगलितसुरभिर्मूत्रेण, a variant in A, which has no metre at all.

(2) A reads शतभाण्डितरसवसया, which has no sense.

(3) तिल is not found in B.

(4) A reads माक्षौक, which seems to be incorrect.

(5) कुसुमफलशवापचकटैरुपेतान् is an incorrect text in A.

(6) A reads कृत्वा तत्खण्ड्यस्तान्, which is incorrect.

(7) A has विपुलतरशिलापृष्ठगानातिशुष्कान्.

दग्धं काण्डैस्त्रिलानां करिसुरभिहया-

शोभिरासाव्य वस्त्रैः¹

भस्म त्यक्त्वा जलं तत्² सदुशिखिनि पचेत्

हंसपाकेन भूयः³ ॥

[टीका—चारजलपाकलक्षणमाह—]

तच्छुष्यमाणं हि सवास्वबुद्बुदान्

यदा विधत्ते⁴ क्षणभङ्गरान् बहन् ।

तदा क्षिपेत् चूषणं⁵ हिङ्गुगन्धकं

चारचयं सप्तवर्णानि भूखगम्⁶ ॥

(1) A reads करिसुरभिहयीद्राजकानां च मूचे.

(2) A reads हं. which is incorrect.

(3) A reads दावत्.

(4) A reads erroneously दद्या बहते.

(5) A reads क्षिपेत् चूषण. B reads क्षिपेन्मूषण. Both the readings are incorrect.

(6) A has चारवितयं पटुलवर्णं भूमिखगं, which mars the metre.

द्रव्याणि संमित्रा निवृत्त्य भूतले
व्यवस्थितान्स्रिकटोरिकापुटे¹ ।
संस्थापयेत् सप्तदिनानि धान्यगं
ततः प्रयोज्यं रसजारणादिकम् ॥

[टोका—जारणायां चारविधानमाह—]

जम्बीरबीजपूरकं चाङ्गेरीवेतसाम्बसंयोगात् ।

चारा भवन्ति नितरां गर्भद्रुतिजारणे शस्ताः³ ॥

[टोका—रसे विडयोजनमाह—]

विडमधरोत्तरमादौ दत्त्वा सूतस्य चाष्टमांशिन⁴ ।

कुर्याज्जारणमेवं क्रमक्रमाद्वैद्येदग्निम्⁵ ॥

(1) A reads व्यवस्थितान् स्रिकटोरिकामुखे । B reads व्यवस्थितशस्त्रकटोरिकापुटे ।

(2) A reads बीजपूरकं, which is incorrect. The word बीजपूर is not found in B.

(3) गर्भद्रुतिजारणा शस्ता is an incorrect variant in A.

(4) A has दत्त्वा सूतं चाष्टमांशिन, which is not correct as it destroys the metre as well as the sense.

(5) A reads वैद्येदग्निः, which is grammatically incorrect.

अष्टमः पटलः ।

[टीका—अथ रसरगोऽभिधास्यते—

अभ्रकजीर्णस्य क्षायाविशेषमाह—]

जीर्णाभ्रको^१ रसेन्द्रो

दर्शयति^२ घनानुकम्पिनीं क्षायाम्^३ ।

कृष्णां रक्तां पीतां

सितां^४ तथा सङ्करं मिश्राम्^५ ।

(1) A reads जीर्णाभ्रक, which mars the metre.

(2) A reads दर्शयति, which is incorrect.

(3) घनानुकम्पिनी क्षाया is the variant in A. घनानुकम्पिनी-
क्षाया is the variant in B. Both the readings seem to be
incorrect.

(4) कृष्णं रक्तं पीतं शितं is the reading in A, which is
incorrect.

(5) A reads ददा संकरीक्षिद्याः, which is incorrect.

[टीका—अभ्रकयोगाद्वयविशेषमाह—]

कृष्णाभ्रकेण बलवत्¹ सितरागैर्युज्यते² रसेन्द्रसु ।

शेतै रक्तैः पीतैः वज्रैः खलु वर्णतो ज्ञेयः³ ॥

[टीका—अथ रञ्जितरसप्रशंसामाह—]

अथ निजमेव हि वर्ण⁴

न जहाति यदा स रज्यते⁵ रागैः ।

क्रमशो हि भक्ष्यमाणो⁶

निर्निज्ञो⁷ रञ्जनं कुरुते ॥

(1) चेतानकेन बलवान् is the variant in A, which is incorrect.

(2) A reads शितरागैः पूर्यते.

(3) A has नविद्रुतो ज्ञेयं, which has no clear sense. B has वज्रवर्णतो ज्ञेयः, which mars the metre.

(4) B reads अथ निजकर्मवर्ण, which is not correct.

(5) A reads यदा रसजीर्यते, which is grammatically incorrect.

(6) A reads भक्ष्यमाणा, which is incorrect. B reads क्रमशो वचमाणी, which is also incorrect.

(7) A reads नारकी.

[टीका—अभ्रसत्त्वादौनां योगे रसे व्यवस्थामाह—]

बलमास्तेभ्रकसत्त्वे जारणरागाः प्रतिष्ठितास्तीक्ष्णे¹ ।

बन्धश्च सारलोहे² सारणमथ³ नागवज्राभ्याम्⁴ ॥

[टीका—सर्व्वकरणं तीक्ष्णमाह—]

क्रामति तीक्ष्णेन रसः तीक्ष्णेन⁵ जौर्यते क्षणाद्वासः⁶ ।

हेम्नो योनिस्तीक्ष्ण⁷ रागान् गृह्णाति तीक्ष्णेन ॥

[टीका—तीक्ष्णहिङ्गुलयोगेन गुणाधिक्यमाह—]

तदपि च दरदेन हतं हत्वा माचीकेण रविसहितम्⁸ ।

वासितमपि वासनया घनवच्चार्य्यश्च जार्य्यश्च ॥

(1) A reads erroneously प्रतिष्ठिता तीक्ष्णा.

(2) A reads सारणलोहे; which is incorrect.

(3) A reads क्रामणमथ.

(4) B reads नागवज्रमत;

(5) A reads तीक्ष्णे च.

(6) A reads रासे, which is incorrect

(7) A reads ज्योतिस्तीक्ष्णे, which has a defective metre

(8) B has omitted हत्वा माचीकेण रवि.

[टोका—तीक्ष्णवदेनानाह—]

कान्तं वा तीक्ष्णं वा काङ्क्षीं वा वज्रसस्यक वापि¹ ।

एकतमं सर्व्वं वा रसरजने सङ्करोऽभीष्टः² ॥

[टोका—स्ने स्ने विकारि वक्ष्यमाणमाह—]

कुटिले³ बलमप्यधिकं रागस्तीक्ष्णे तु पन्नगे स्नेहः⁴ ।

रागस्नेहबलानि तु कमले शंसन्ति धातुविदः⁵ ॥

सर्व्वैरेभिर्लोहैर्मात्तकसहितैर्मृतिस्तथा गर्भे ।

विड्योगिनं तु जीर्णो रसराजो विशति लोहेषु ॥⁶

[टोका—रसबन्धानां मारणे विधानमाह—]

तालक⁷दरदशिलाभिः स्नेहक्षाराम्ललवणसहिताभिः ।

(1) काङ्क्षीं वा वज्रसस्यकादीनां, a variant in B.

(2) रसेपि हि रसायने विद्यात्, a variant in A.

(3) This is not found in B.

(4) A reads erroneously पन्नगस्नेह.

(5) A reads धातुविधं, which is incorrect.

(6) This sloka is not found in B.

(7) A reads तारक.

समकद्विगुणत्रिगुणान् पुटो वह्नेद्वज्जशस्त्रादीन्¹ ॥

[टौका—पुटितधातुक्त्यमाह—]

रक्तस्नेहनिषेकैः सेकं² कुर्याद्रसस्य पिष्टिरियम्³ ।

चारणजारणमात्रात् कुरुते रसमिन्द्रगोपनिभम् ॥

[टौका—मुख्यत्वेन ताम्रप्रशंसनमाह—]

अथवा⁴ केवलममलं कमलं दरदेन वापितं कुरुते ।

त्रिगुणं जीर्णं जीर्णं⁵ लालारससन्निभं सूतम् ॥

[टौका—विध्यन्तरमाह—]

रक्तगणगलितपशुजल-

वहु⁶भाविताप्यगन्धकशिलानाम्⁷ ।

(1) निवाहयेद्वज्जः शस्त्रादीन्, a variant in A, which has a defective metre.

(2) B reads श्लेष्म.

(3) A reads कृष्टिर्यम्, which is incorrect.

(4) B reads erroneously अथ.

(5) त्रिगुणं हि जीर्णंजीर्णं, a variant in B.

(6) The word बहु is omitted in B, which renders the metre defective.

(7) A reads गन्धकशिलाभिः.

एकेन वापितमृतं¹

कमलं रञ्जयति रसरजम् ॥

[टौका--रागाधिकारि-गन्धकादीनाह--]

वाह्यो गन्धकरागो² विलुलितरागी³ मनःशिलाताले ।

माचौक⁴सत्त्वरसकौ द्वावेतौ⁵ रञ्जने शस्तौ ॥

[टौका--प्रधानयोः ताम्रखर्परयोः कृत्यमाह--]

क्रमवृद्धैः रविरसकैः⁶ संशुद्धो मूकमूषिकाध्यातः⁷ ।

(1) A reads वापितमृतं, which seems to be incorrect.

(2) A reads गन्धकराग, which is incorrect.

(3) A reads अतिरागो. B reads विलुलितरागी. Both the readings are grammatically incorrect.

(4) B reads माचिक, which mars the metre.

(5) B reads द्वावे हि, which seems to be incorrect.

(6) A reads क्रमवृद्धै रविरसकैः. B reads क्रमवृद्धौ रविरसकौ.

We have adopted the above reading after collating the texts.

(7) मूषिकामुनिध्यातः, a variant in A, which mars the metre. मूकमूषिकाध्यातौ, a variant in B.

त्रिगुणं जीर्णो जीर्णो¹ हेमाभो जायते² सूतः ॥

[टीका—अभ्रकयोगमाह—]

अथ³ कृष्णाभ्रकचूर्णं पुटितं रक्तं भवेत्तथा⁴ शकलम् ।

त्रिगुणं जीर्णो जीर्णो⁵ हेमद्रुतिसंनिभः सूतः⁶ ॥

[टीका—स्वर्णमारणमाह—]

त्रिगुणेन माक्षिकेन तु कनकं च सूतं रसतालयुतम्⁷ ।

पटुसहितं तत् पक्वं हण्डिकया यावदिन्द्रगोपनिभम् ॥

(1) A reads जीर्णे जीर्णे. B reads जीर्णो जीर्णो.

(2) A reads द्रुतिहेमनिभी भवेत्, (द्रुति—द्रुत). B reads हेमवर्णाभी जायते, which mars the metre.

(3) A reads अथवा, which destroys the metre.

(4) A omits तथा.

(5) A reads जीर्णे जीर्णे, which seems to be incorrect. B reads जीर्णो जीर्णो.

(6) हेमद्रुति(?)संनिभी भवेत् सूतः, a variant in A.

(7) कनकच रसतालयुतं, a variant in A, which is a defective metre. The reading of B, which we have adopted, is also a defective metre. The word चेत् or स्यात् should be added after the word युतम्.

[टीका—एतद्वस्त्रजीर्णसूतस्य लक्षणमाह—]

तच्चूणे सूतवरे त्रिगुणं जीर्णे हि^१ जीर्णे तु ।

द्रुतहेमनिभः सूतो^२ रज्यति लोहानि सर्वाणि^३ ॥

[टीका—सर्वेषां धातूनां रसानामुत्तरोत्तरविशेषत्व-
माह—]

पत्रादष्टगुणं सत्त्वं सत्त्वादष्टगुणं द्रुतिः ।

द्रुतेरष्टगुणं बीजं तस्माद्वीजं तु जारयेत् ॥

(1) A reads जीर्णे तु. B reads बीर्णे हि.

(2) द्रुतहेमनिभसूती, a variant in A, which seems to be incorrect.

(3) A has जरति लोहानि सत्वानि. B has रज्यति लोहानि सर्वाणि. Both the readings have defective metre.

(4) This verse is found in A after the verse तारक
दरदशिलाभिः &c, (vide ante pp 28—29) and runs thus :—

पत्रादष्टगुणं दत्त्वा सत्त्वादष्टगुणं द्रुतिः ।

द्रुतेरष्टगुणं बीजं तस्माद्वीजं तु जारयेत् ॥

नवमः पटलः ।

[टीका—बीजप्रशंसनमाह—]

इति रक्तोपि रसेन्द्रो बीजेन विना न कर्मल्लदभवति ।

द्विविधं तत् पौतसितं¹ नियुज्यते सिद्धयेच रसम्² ॥

[टीका—रसोपरसधातूनां बहुविधत्वात् शोधन-
माह—]

तस्य विशुद्धिर्बहुधा³ गगनरसोपरसलोहचूर्णैश्च ।

द्विविधं बीजं तैरपि नाशुद्धैः शुध्यते कदाचिदपि⁴ ॥

[टीका—अशुद्धबीजप्रभावमाह—]

यः पुनरैतैः कुरुते कर्माशुद्धैर्भवेद्रसस्तस्य ।

(1) B reads पीतं सितं which destroys the metre.

(2) नियुज्यते सिद्धयेच रसः, an incorrect variant in A. नियुज्यते सिद्धयेव तत्, a variant in B. Both texts are collated in our adopted reading.

(3) रसति शुद्धिर्वाच्या, a variant in A, wherein the first term seems to be incorrect.

(4) B reads नैतत् instead of कदाचिदपि. This is incorrect ; since it contains two negatives.

अव्यापकः पतङ्गो¹ न रसे न रसायने योग्यः² ॥

[टीका—रससंज्ञकानाह—]

वैक्रान्तकान्त³सस्यकमाक्षिक⁴विमलाद्रिदरद-

रसकाय⁵ ।

अष्टौ रसास्तथेषां सत्त्वानि⁶ रसायनानि स्युः ॥

[टीका—उपरससंज्ञकानाह—]

गन्धकगैरिकसुशिला⁷क्षितिखेचरमञ्जनञ्च

कङ्कुष्ठम् ।

उपरससंज्ञमिदं⁸ स्यात् शिखिशिनी सारलोहाख्यौ ॥

(1) अव्यापकपतङ्गि, a variant in A, which is incorrect.

(2) A reads योग्ये. B reads रसापनयने योग्यः. Both the readings are incorrect.

(3) A omits कान्त,

(4) A reads माक्षिक, which mars the metre.

(5) A reads दलदरसकैय.

(6) A reads चत्वारि, which is not accurate.

(7) B reads मिमालक, which destroys the metre.

(8) B reads संज्ञकमिदं, which mars the metre.

[टीका—पूतिसंज्ञके आह—]

ताम्बारतोष्णकान्ताभ्रवज्रलोहानि¹ नागवज्रौ च² ।

कथितौ च पूतिसंज्ञौ³ तेषां संशोधनं कार्यम् ॥

[टीका—लवणचारसंज्ञे आह—]

सौवर्चलसेम्भवकं चूलिकसामुद्ररोमकविडानि ।

पङ्कलवणान्येतानि तु सर्जयिवटङ्गणाः चाराः ॥⁴

[टीका—शोधकद्रावकगणमाह—]

सूर्यावर्तः⁵ कदली कन्धा⁶ कोशातकी च सुरदाली ।

शौगुथ⁷ वज्रकन्दो नीरकणा काचमाची च ॥

आसामेकरसेन तु लवणचारान्न नाविता बहुयः ।

शुद्धान्ति रसोपरसा धाता मुञ्चन्ति सत्त्वानि ॥⁸

(1) B reads सत्वलोहानि.

(2) B reads वज्रनागौ च.

(3) B reads कथितौ कुम्भसंज्ञौ, which is incorrect.

(4) This verse is not found in A.

(5) A reads सूर्यावर्चक.

(6) B reads बन्धा.

(7) A reads शिशुथ.

(8) This verse is found in A only.

[टीका—शोधकद्रावकाणां शोधनद्रावणविधान-
माह—]

स्त्रिंशं सचारास्त्रैः¹ धातं वैक्रान्तकं हठाद्भवति² ।

तद् द्रुतमात्रं³ शुध्यति कान्तं शशरक्तभावनया ॥

[टीका—तच्चाह—]

सस्यकमपि रक्तगणैः⁴ सुभावितं स्नेहरागसंयुक्तम्⁵ ।

शुध्यति वारैः⁶ सप्तभिरतः परं युज्यते कार्ये⁷ ॥

[टीका—तच्चाह—]

चारैः स्नेहेरादौ पद्यादास्त्रेण⁸ भावितं विमलम् ।

(1) A reads सचारास्त्रै.

(2) A reads हठाद्भवति, which is incorrect.

(3) A reads तद्द्रुतमात्रे, which is incorrect.

(4) B reads रसुगणैः, which seems to be incorrect.

(5) भावनतः स्नेहरागसंयुक्तं, a variant in A.

(6) A reads वारैः.

(7) सप्तभिरतः परं योजयेत् कार्ये, a variant in A, which mars the metre. B reads सप्तभिरभितः परं, wherein अभितः is incorrect as well as a defective metre.

(8) B reads पद्यात् उच्चेन.

शुध्यति तथा च रसकं दरदं माचीकमप्येवम्¹ ॥

[टीका—ताम्रशोधनमाह—]

तनुरविपत्रं लिप्तं² लवणक्षारास्तरविस्त्रुक्क्षीरैः³ ।

धातं निर्गुण्डीरससिक्तं बहुशो वहेद्द्रवत्वञ्च⁴ ॥

[टीका—लोहशोधनमाह—]

शुध्यति नागो वङ्गो घोषो रविणा च वारमुनिसंख्यैः⁵ ।

निर्गुण्डीरससिक्तैस्तन्मूलरजःप्रवापैश्च ॥

[टीका—तच्चाह—]

(1) दरदमाचीकमप्येवं तथा शुध्यति, a variant in A, where-
in the last two words are superfluous and incorrect.

(2) B reads तनुरपि पत्रलिप्तं, which has no sense.

(3) A reads सुक्षि. B reads सुक्ष्मा. Both the readings
destroy the metre.

(4) A reads बहुशो वहेद्द्रवत्वं. B reads बहुशो द्रवत्वञ्च.
Both the readings are defective.

(5) घोषो रविरोधमपि च मुनिसंख्यैः, a variant in A. B
reads रविणा च वारमुनिभिः. Both the readings are in-
correct.

(6) B reads सिक्ते, which is not correct.

रक्तगणगलितपशुजलभावितपुटितं च रज्यते¹ तीक्ष्णम् ।

शुद्धति कदलीशिखिरसभावितपुटितं² त्रिभिर्वारैः ॥

[टीका—मारणमाह —]

सर्व्वः शुद्धति लोहो रज्यति³ सुरगोपसन्निभो वापात् ।

माक्षिकसत्त्वे भृङ्गं⁴ शुक्लं वा गन्धकेन हृतम्⁵ ॥

एकादशः पटलः ।

ह्यागास्थिभस्मनिर्मितमूषां कृत्वैवामलकाकारां ।

दलयोगे घनरन्ध्रां टंकणविषगुञ्जकतलेपां ॥

(1) A reads रज्यते, which is incorrect.

(2) शुद्धति कदलीशिखिरसभावितं पुटितं, an incorrect variant in B.

(3) A and B read रज्यति, which is grammatically incorrect.

(4) A reads सङ्गं. B reads दरदेन भ. Both are unintelligible.

(5) A reads शुक्लेन वा गन्धकेन हृतं. B reads सृतं.

[टीका—अथ ग्रन्थकारयितुर्वंशवर्णनमाह—]

श्रीतांशुवंशसम्भवहैहयकुलजन्मजनितकुलमहिमा ।

जयति श्रीमदनरथः^१ किरातनाथो रसाचार्यः ॥

[टीका—अथ चास्य कारयितुर्गुणवर्णनमाह—]

यस्य स्वयमवतीर्णा रसविद्या सकलमङ्गलाधारा^२ ।

परमश्रेयसहेतुः श्रेयसि परमेष्ठिनः पूर्व्वम्^३ ॥

येन चतुर्वर्णस्त्रैच्छादिव्याधादिलब्धसत्त्वाभम्^४ ।

दक्षिणरसा गृहीता^५ आदिवराहेणेव महाप्रलये ॥

(1) कुल is not found in B.

(2) स जयति श्रीमदनरथ, a variant in B.

(3) C reads सकलमङ्गलाधारा.

(4) Of the latter half C has only परं सहेतुः.

(5) C reads चतुर्वर्णस्त्रैच्छादिव्याधादिलब्धसत्त्वाभम्, which seems to be incorrect. Cf. Patala I., in which the following verse is given :—किरातगोपादिकतापसाद्यवनेचरास्तत्कुम्रलाशयान्ते । विदन्ति नानाविधभेषजानां प्रमाणवर्णोक्तितानामजातीः ॥

(6) दक्षिणरस गृहीता is the incorrect reading in C. [In the case of किरातनाथ रसाः गृहीताः i. e. collected रस—mercury, minerals &c. and दक्षिण is favorable ; and in the case of आदिवराह रसा गृहीता i. e. lifted up the earth.]

(7) This verse and the next are not found in B.

नष्टशरीरविवर्णा हीनाङ्गाः कुष्ठिनो गुणादयस्व ।

अभिनवसोमेश्वरतामापुरपि पुनर्नवैरङ्गैः ॥

[टीका—कर्त्ता स्वनाममहत्त्वं सूचयन्नाह—]

तस्मात् किरातनृपतिः बहुमानमवाप्य रससुकर्म्मरतः¹ ।

रसहृदयाख्यं तन्त्रं² विरचितवान् भिन्नुगोविन्दः³ ॥

नम्रा मङ्गलविष्णोः सुमनोविष्णोः सुतेन तन्त्रोद्यम्⁴ ।

श्रीगोविन्देन कृतः⁵ तथागतः श्रेयसे भूयात् ॥⁶

अष्टादशसंस्कारं रसेन्द्रदेवस्य दिव्यतनु दृष्ट्वा ।

लिखितमिदं पुण्यतमं रसहृदयमवाप्यते सकलम् ॥

(1) C reads रसकर्मोपदेशती दृष्ट्वा, which destroys the metre.

(2) C reads रसहृदयेषसं, which seems to be incorrect.

(3) C reads विरचिताया मगवद्गोविन्दः, which is incorrect.

(4) C has रसाटव्यनाम तन्त्रोद्यम्, which is incorrect.

(5) C has श्रीमदभगवद्गोविन्देन कृतं, which mars the metre.

(6) This verse and the next are not found in B.

इति श्रीमद्भगवद्गोविन्दविरचितं

रसहृदयं समाप्तम् ।¹

शुभससु ।

संवत् १६०४ समये ज्येष्ठ वदि १३ भौमे

जगन्नाथभट्ट लेखि ॥

श्रीराम हल संवत् १८८० पौष वदि ३ भौमे ।

(1) MS. A ends abruptly with the colophon, which runs thus :—इति श्रीगोविन्दभगवत्पादविरचिते रसहृदये श्रीरस-
क्रियाधिकार एकविंशतितमः पटलः ॥ The author's account
of himself is altogether wanting in it. B has "इति सकल-
रसवैद्यकुलकिरीटभूषायमाणारुणपादपद्मरामसकलविद्यापारोक्ष श्रीमद्भिक्षु-
गोविन्दकृती रसहृदयः समाप्तः । इति श्रीमत्कुरलवंशपयोधिसुधाकर-
मिश्रमुद्रेशात्मजश्रीचतुर्भुजविरचितायां खण्डे बाला-
न्वयबोधिकाख्यायां रसहृदयटीकायां रसप्रशंसात्मक एकीनविंशीऽवबोधः ।
इति श्रीः" ॥

Extracts from
KAKACHANDESVARIMATA.

काकचण्डेश्वरीमततन्त्रात्

समुद्धृताः श्लोकाः ।

ॐ नमः सदाशिवाय ।

कैलासशिखरासीनमुमा रुद्रं जगद्गुरुम् ।
क्रन्दनंदीमहाकालौ भृंगचण्डीविनायकौ ॥ १ ॥
योगिनीनामष्ट तत्र गुह्याद्गुह्यतरं परम् ।
कपाली कालरात्रौ च कालचंद्रकलाम्बिका^१ ॥ २ ॥
कराली कालकर्णी च काकचण्डेश्वरी तथा ।
एवमादिस्तथा चान्या योगिनीगणगुह्यकैः^२ ॥ ३ ॥

(1) The text reads कालचंद्रकलाम्बिका, which is incorrect.

(2) The text reads गुह्यकौ, which is incorrect.

नृत्यवाद्यसुखेशानैः सानन्दैर्दृष्टचेतसैः ।
 तत्रस्थं भैरवं देवं योगिनौगणवेष्टितम् ॥ ४ ॥
 केचित् स्तुवन्ति संहृष्टाः केचिद्विदुषो गुह्यकाः ।
 केचिन्नृत्यन्ति गुह्या ये केचिद्वाद्यं न कुर्वते ॥ ५ ॥
 हृष्टितं^१ भैरवं देवं पञ्चवक्त्रं त्रिलोचनम् ।
 तं दृष्ट्वा भैरवी हृष्टा जगतां त्रिदशेश्वरी ॥ ६ ॥
 कृताञ्जलिपुटा भूत्वा कृष्णतारकलोचना ।
 काकचण्डेश्वरी देवी उवाचेदं तु भैरवी ॥ ७ ॥

काकचण्डेश्वरी उवाच ।

भगवन् देवदेवेश सर्वज्ञ सर्वविच्छिन्न^२ ।
 सर्वज्ञानप्रकाशाय अहं पृच्छामि शंकर ॥ ८ ॥
 कथं कायस्थितो जीवो जीवकोऽसौ प्रकीर्तितः ।
 कायस्थः कर्मणा केन स्थितः संसारपञ्जरि ॥ ९ ॥
 जराव्याधिदारिद्रेण यस्तुः संसारबंधनैः ।
 एको ब्रजति यानेन एकः स्कंधे वहेच्च तम् ॥ १० ॥

(1) The text reads हृष्टनं, which is not correct.

(2) The text reads सर्वच्छिन्नः, which is not correct.

जयजयशब्दं मांगल्यमेकस्थाने च जंतवः ।

किं कुर्वाणाः प्रकुर्वाणाः कस्मान्मे ब्रूहि शंकर ॥ ११ ॥

श्रीसर्वज्ञ उवाच ।

शृणु त्वं काकचामुंडे साधकानां हितं प्रिये ।

गुह्याद्गुह्यतरं वाक्यं पृष्टोऽहं तु वरानने ॥ १२ ॥

कथयामि समासेन शृणु त्वं काकचामुंडके ।

यस्यार्थश्च परो नित्यः अनादिनिधनेश्वरः । १३ ॥

सुरूपो निर्गुणः शांतो विश्वव्यापी परात्परः ।

अनादिकर्मसंबन्धः कायस्थो भवति तु सः ॥ १४ ॥

जीवे व्याधिभयं कर्म अज्ञानात् संप्रकीर्तितम् ।

तस्मात् कर्मभवात् क्लिष्टः संसारे संसरति सः ॥ १५ ॥

करोति विविधं कर्म संसारे काममोहितः ।

द्रव्योपायं न जानाति कामभोगार्थहेतुना ॥ १६ ॥

कायक्लेशेन मानव्यो द्रव्योपायं करोति सः ।

क्षपिवाणिव्यसेवायां मेषाविक्रयविक्रये ॥ १७ ॥

(1) The text reads काकचते, which is incorrect.

(2) The text reads करोतु, which is not accurate.

(3) The text reads कालक्लेशेन, which is not correct.

वहन्ति काष्ठभारांश्च लणभारमनेकधा ।
 यानं यवनच्छत्रं^१ च किं करोति^२ करोति सः ॥ १८ ॥
 कामासक्तनरः श्रीमान् कुरुते कर्म नैकधा^३ ।
 कुर्वाणाश्च नराः केचित् कामासक्तार्यचिन्तकाः ॥ १९ ॥
 जायंते मर्त्यलोकेऽस्मिन् दारिद्र्योपहतचेतसः ।
 जायंते नात्र संदेहो कुलखंजा नृपुंसकाः ॥ २० ॥
 महासंसारबंधेन त्रिगुणेन सुयन्त्रिताः ।
 अटव्यां घोरसंघट्टघाटिकां तु नयन्ति तत् ॥ २१ ॥
 एतत्ते कथितं भद्रे यत्त्वं मां परिपृच्छसि ।
 किमन्यत् पृच्छसे भद्रे तथा ते कथयाम्यहम् ॥ २२ ॥
 इति काकचंडेश्वरीमते प्रथमः पटलः ।

श्रीकाकचण्डी उवाच ।

कथयस्व महादेव कामभोगप्रसाधनः ।
 अर्थः संपद्यते येन अक्षीयात् परमेश्वर ॥ १ ॥

-
- (1) The text reads यवनच्छत्रं, which is incorrect.
 (2) The text reads किं कुर्वति, which is incorrect.
 (3) The text reads कुरु कर्ममनेकधा, which is incorrect.

तदहं श्रोतुमिच्छामि कथयस्व प्रसादतः ।

आकाशगमनं देव खेचरत्वं यथा भवेत् ॥ २ ॥

पादुकाया दले पंचदिव्यस्त्रीकामसाधनम् ।

रोचनं अंजनं चैव धातुवाटरसायनम् ॥ ३ ॥

जलूकाबंधमित्याहुः रसस्य मारणं कथम् ।

जारणं रत्नकर्तृत्वं वज्रीभद्रावणं कथम् ॥ ४ ॥

एतत् सर्वं समासेन ब्रूहि मे त्रिपुरांतक ।

श्रीभैरव उवाच ।

शृणु त्वं काकचाभुंडे साधकानां हितं प्रिये ॥ ५ ॥

कथयामि समासेन पृथक् सिद्धार्थसाधनम् ।

न द्रव्येण विना सिद्धिर्न भोगाः काम एव च ॥ ६ ॥

द्रव्यहीना नरा मर्त्ये प्रेतरूपेण संस्थिताः ।

अटंति मर्त्यलोकेऽस्मिन् पर्युपद्रवकारणम् ॥ ७ ॥

• • • विवं (?) तेषां जायतोपि मृतश्रुतेः ।

कुलं सौभाग्यरूपं च पांडित्यं ज्ञानसंस्थितम् ॥ ८ ॥

द्रव्यहीना न शोभन्ते प्राणहीना नरा यथा ।

कुक्षितो घ्राणहीनोपि केनापि वधिराः स्थिताः ॥ ९ ॥

पद्यन्ति मर्त्यलोकेऽस्मिन् द्रव्यस्थं मकरध्वजम् ।

तस्मात् संसाधयेद्देवि रसेन्द्रं साधकोत्तमः ॥ १० ॥

अथातः संप्रवक्ष्यामि रसेन्द्रसाधनं तव ।

मारणं जारणाद्यं च द्रव्यसाधनमुत्तमम् ॥ ११ ॥

वज्रदंडः सुदंडश्च लोहदंडस्तथैव च ।

तयो विना ओषधये रसस्य मारणे हिताः ॥ १२ ॥

तान्नि बोध समासेन यथा जानन्ति साधकाः ।

वज्रदंडस्तु वज्री स्यात् लोहदंडं पुटं विडः ॥ १३ ॥

सुदंडं ब्रह्मदंडं च समासात् कीर्तितं तव ।

ग्राहयेत्तं समासेन साधकः हृष्टमानसः ॥ १४ ॥

तद्रसं रससंयुक्तं एकीकृत्य तु मर्दयेत् ।

अंधमूषागतं धातं रसं म्रियेत तत्क्षणात् ॥ १५ ॥

सहस्रवेधी कर्त्ता च ज्ञायते स महारसः ।

मूषां संलेपयेत् तेन पुरागृह्य महौषधीः ॥ १६ ॥

अंधयित्वाग्निमध्ये तु रतिबंधः अयं विधिः ।

पश्चात् पलसहस्रैकं शुल्बस्य ग्राहयेद्बुधः ॥ १७ ॥

अस्त्रवर्गहतं शुल्बं चारवर्गहतं शुभम् ।

वज्रीचीरार्कचीरेण मर्दयेत् शतधा नरः ॥ १८ ॥

पुटं दद्यात् समासेन कालिकारहितं भवेत् ।

मूषागर्भोदरे क्षिप्वा धामयेत् खुदिरानलैः ॥ १८ ॥

रसेन्द्रः क्षिप्यते तत्र तारं संजायते क्षणात् ।

अथातः संप्रवक्ष्यामि मूषाबंधं यथा भवेत् ॥ २० ॥

मृत्तिकाः ग्राहयेत् प्राञ्जस्तृणपाषाणवर्जिताः ।

तुषादग्धास्तयो ग्राह्या मृदुभागास्तु त्रयस्तथा ॥ २१ ॥

एकोक्तत्वं तु संबंधे मूषां तत् कारयेद्विबुधः ।

गोस्तनाकारसदृशौमयवामलकं कुरु ॥ २२ ॥

मूषाबंधमिति ख्यातं साधकानां हिताय वै ।

अथान्यत् संप्रवक्ष्यामि रसस्य मारणं यथा ॥ २३ ॥

ग्राहयेत् पूर्ववद्विबुधः श्लोषधीस्तिक्तः साधकः ।

मूषां संलेपयेत् तेन धाम्य कर्म समाचरेत् ॥ २४ ॥

रसेन्द्रो म्रियते क्षिप्रं कुरु कर्म यदिच्छया ।

वीतोदकेन कामेन हेमकर्माणि वा मृणु ॥ २५ ॥

कारयेज्जोहमयं पात्रं तस्योर्ध्वं मृन्मयं शुभे ।

अन्योन्यपृष्ठसंलग्नं कारयेत् साधकोत्तमः ॥ २६ ॥

अधोयन्त्रेण तं धाम्य प्रायसं तत्र जाययेत् ।

तप्तखल्वोदरे घृष्टं जरते नात्र संशयः ॥ २७ ॥

तद्गुणं आयसं तच्च हेमं चाष्टगुणं ददेत् ।

क्षीरवज्रं तथा चारी षट्जारी उदिरग्रही । (१)

ग्राहयित्वा रसं तेषां आयसं जारयेन्नरः ॥ २८ ॥

हेमं संजायते तच्च धर्मीकामार्थसाधनं ।

गृह्य स्वल्पोदरे तप्ते हेमं षड्गुणतां भजेत् ॥ २९ ॥

पुरा महीषधैर्युक्तं जरते नात्र संशयः ।

जारिते सारितं दद्यात् पुनस्तं जारयेदर्याद ॥ ३० ॥

कुरुते कर्मसंघांश्च कर्म सिद्ध्यर्थसाधनं ॥ ३१ ॥

जारणं मारणं चैव समासात् कौर्त्तितं मया ।

किमन्यत् पृच्छसे भद्रे तथा ते कथयाम्यहम् ॥ ३२ ॥

इति श्रीकाकचण्डेश्वरीमते द्वितीयः पटलः ।

अथान्यं संप्रवक्ष्यामि अभ्रकस्य यथाक्रमम् ॥ २० ॥

द्रावणं अभ्रकस्येव समासेन विधीयते ।

क्षीरकंचुकिचूर्णेन तद्रसेनाभिभावितं ॥ २१ ॥

निर्गुण्डीवज्रदण्डं तु तद्रसे भावितं कुरु ।

एकैकं सप्तवारैस्तु भावयेत् साधकोत्तमः ॥ २२ ॥

(भावनान्ते) अभ्रकस्य अस्ते क्षिपेद्दिनत्रयं ।

ब्रह्म्या सप्तरात्रं तु क्षिपेद्भ्रं नरोत्तमः ॥ २३ ॥

तेन कल्केन पत्राणि लेपयेदभ्रकस्य च ।
 कांस्यपात्रेण * * * स्तारि साधकोत्तमः ॥ २४ ॥
 सूर्यधाम्नि ततो धाप्यः सप्ताहं साधकोत्तमः ।
 द्रवते नात्र संदेहः प्रियं दृष्ट्वा यथा स्त्रियः ॥ २५ ॥
 रसस्य भागमेकं तु द्रुतभागसमं कुरु ।
 एकोक्त्य तु तद्वाम्यं म्रियते नात्र संशयः ॥ २६ ॥
 ललांशवेधकोऽसौ हि जायते नात्र संशयः ।
 अथान्यं संप्रवक्ष्यामि यथा संजायते द्रुतिः ॥ २७ ॥
 ग्राहयेदभ्रकं प्राज्ञः पीतं वा कृष्णमेव वा ।
 पुरा संस्कारयुक्तं तु कर्त्तव्यं साधकेन तु ॥ २८ ॥
 यवामा चित्रकं धारः कंचुकीवज्रदंडयोः ।
 वज्रकंदार्कशीरं च भक्तातं टंकणं तथा ॥ २९ ॥
 चारत्रयसमायुक्तं पट्पंचसमन्वितं ।
 एकोक्त्य तु कल्केन अभ्रपत्राणि लेपयेत् ॥ ३० ॥
 मूषागर्भोदरे क्षिप्वा धामयेत् खादिरानलैः ।
 द्रवते नात्र संदेहो * * * * *

इति काकचंडेश्वरीमते षष्ठः पटलः ।

Extracts from
RASENDRACHUDAMANI.
सोमदेवविरचितात् रसेन्द्रचूडामणेः

उद्धृताः श्लोकाः ।

रूप्येण सह संयुक्तं धातं रूप्येण चैकगत्^१ ।
तदा निरुत्यमित्युक्तं लोहं तदपुनर्भवम् ॥
एवं रूप्यं सनागं चेत् धातं ताम्रं लगेन्नहि ॥

—

निष्कमात्रे तु नागोऽस्मिन् लोहखार्यां हृते सति ।
स्वतो लज्जगुणां हेमीं शलाकां ग्रसति ध्रुवम् ॥
कुसुमैतैलतप्तं तत् स्वर्णमुद्गिरति^२ ध्रुवम् ।
गुह्यनागोऽयमुद्दिष्टो वक्ति^३ स्वच्छन्दभैरवः ॥

(1) The text reads लघु. But रसरत्नसमुच्चय reads लगेत्,
which seems to be correct.

(2) The text reads स्वर्णे मुद्गिरि, which is incorrect.

(3) The text reads मुद्दिष्टवक्ति, which has no sense.

तीक्ष्णं नीलाञ्जनोपेतं धातं हि बहुशो दृढम् ।
 मृदुक्लृष्णं द्रुतद्रावं¹ वरनागं तदुच्यते ॥
 मृतस्य पुनरुद्भूतिः संप्रोक्तोत्थापनाख्यया² ।
 द्रुतद्रव्यस्य निक्षेपो द्रवे तद्भालनं मतम् ॥
 त्रिंशत्पलमितं नागं भानुदुग्धेन मर्दितम् ।
 विमर्दं पुटयित्तावत् यावत् कर्षविशेषितम् ॥
 न तत् पुटसहस्रेण क्षयमायाति सर्व्वथा³ ।
 चपलोऽयं समुद्दिष्टो वात्तिकैर्नागसम्भवः⁴ ॥
 इत्थं हि चपलः⁵ कार्य्यो वङ्गस्यापि न संशयः ।
 तत्सृष्टहस्तसंसृष्टः केवलो बध्यते रसः ॥

(1) The text has द्रुतद्रावी, which is incorrect. We have adopted the text of रसरत्नसमुच्चय.

(2) The text reads साधोक्तस्थापनाख्यया, which seems to be erroneous.

(3) The text has क्षयमायाति सर्व्वदा, which is grammatically incorrect.

(4) The text reads नागसंभवः, which is incorrect.

(5) The text reads इत्थं क्षीरपलः, which is senseless.

स रसो धातुवादिषु शस्यते न रसायने¹ ।
 अयं हि खर्पणाख्येन² लोकनाथेन कौर्त्तितः ॥
 भ्रामकाख्यरजः सूक्ष्मं पञ्चमांशरसान्वितम् ।
 कुमारौमूलतोयेन मर्द्दयेदेकवासरम् ॥
 चाङ्गेरीस्वरसेनापि दिनमेकमनारतम्³ ।
 एवं भूनागधातेन मर्द्दयेद्विवसद्द्वयम् ॥
 अथैकपलमानेन तावता त्रपुणापि च ।
 दशनिष्करसेन्द्रेण श्लक्ष्णपिष्टीं समाचरेत् ॥
 योजयित्वाथ कल्केन यथापूर्वं विमर्द्दयेत् ।
 ततः साररसेन्द्रेण सत्त्वेन रसकस्य च ।
 पिष्टीं कृत्वा तु पूर्व्वेण पूर्व्वकल्केन योजयेत् ॥
 अथ प्रक्षाल्य कोष्णेन⁴ काञ्चिकेन प्रशोषयेत् ।

(1) The text has रसायनम्.

(2) खर्पणाख्येन is the reading in रसरत्नसमुच्चय.

(3) The text reads दिनमेकमनारतम्, which has no clear sense.

(4) The text reads कोष्णेन, which is unintelligible.

पलाहंशुद्धसस्येन भृष्टगुञ्जारसेन च ।
 विमर्दय काञ्चिके कुर्यात् मरिचप्रमितां गुटीम्¹ ॥
 निरुध्य वज्रमूषायां सन्धिवन्धं विधाय च ।
 शुषिरैर्नवभिः² सम्यग्भस्त्राभ्यां च धमेत् खलु ॥
 ततो मूषागतं सत्त्वं समादाय समन्ततः ।
 धमेत् प्रकटमूषायां वङ्कनालेन शुद्धये ॥
 दशशाणं हि तत्सत्त्वं भस्मना लवणेन च ।
 सकाञ्चिकेन संवेष्ट्य पुटयोगेन शोधयेत् ॥
 द्विनिष्कप्रमिते तस्मिन् पूर्वप्रोक्तेन भस्मना ।
 अशीतिगुणितं नागं ध्यात्वा निर्वाहयेत् खलु ॥
 इयता³ पूर्वसूतोऽसौ जीयते न कथञ्चन ।
 चपलोऽयं समुद्दिष्टो लोकनाथेन शम्भुना ॥
 अनेनापि रसः शीघ्रं बध्यते पृथ्ववत् खलु ।
 कारवल्लीजटाचूर्णेर्दशधा पुटितो हि सः ।
 भवेन्नागविनिर्मातो यासं गृह्णात्यशेषतः ॥

-
- (1) The text reads मरिचप्रमिता गुटी, which is incorrect.
 (2) The text reads शुषिरैर्नवभिः, which has no sense.
 (3) The text reads इयता, which is incorrect.

सुखं प्रकटमूषायां भवेच्च विगुणोत्तरम्¹ ।
 जीर्णग्रासो रसोद्घोष देहलोहकरो भवेत्² ॥
 सोऽयं त्रीसोमदेवेन कथितोऽतीव निश्चितम् ॥
 भूभुजङ्गशक्तोयेः³ प्रक्षाल्यापहृत⁴ रजः ।
 कृष्णवर्णं हि तत् प्रोक्तं धौतास्यं⁵ रसवादिभिः ॥

स्वरूपस्य विनाशेन पिष्टतापादनं हि यत् ।
 विष्णुर्द्विर्वर्जितः⁶ सूतो नष्टपिष्टः स उच्यते ॥
 अथ यन्त्राणि वक्ष्यन्ते रसतन्त्राण्यनेकशः⁷ ।
 समालोक्य समासेन सोमदेवेन सांप्रतम् ॥

- (1) The text reads विगुणोत्तरा, which is incorrect.
- (2) The text reads ताये, which is not accurate.
- (3) The text has अपहृतं which is not accurate.
- (4) The text reads धौतास्यं, which is not correct.
- (5) But रसरजसमुच्चय reads विद्वद्भिर्निर्जितः.
- (6) But रसरजसमुच्चय reads अशेषतः.

ऊर्ध्वपातनयन्त्रं हि नन्दिना परिकीर्तितम् ॥

कोष्ठि(ष्टि)कायन्त्रमेतद्धि नन्दिना परिकीर्तितम् ॥

विन्ध्याद्रौ हिमपर्वते च मलये गोमन्तके श्रीगिरौ
सङ्घाद्रावथ पारियात्रकगिरौ किंकिंधिनामालये ।
माहेन्द्रेऽप्यथ चाल्पवत्क्षितिधरे तद्रूपनामाधिकं
गोपाभीरकसिद्धवेद्यमुखतो वैद्यः समावेद्यताम् ॥

इति श्रीकरवालभैरवपुरवरपतिश्रीसोमदेवविरचिते
रसेन्द्रचूडामणौ रससूत्रस्थाने रसमहिम-
निरूपणं नाम प्रथमोऽध्यायः
समाप्तः ।

Extracts from
RASAPRAKASASUDHAKARA.

यशोधरविरचितात् रसप्रकाशसुधाकरात्
उद्धृताः श्लोकाः ।

विमलसूतवरो हि पलाष्टकं
तदनु धातुघटीपटकांचिकाः ।
पृथगिमाद्य चतुःपलभागिकाः
स्फटिकशुद्धपलाष्टसमन्विताः ।
सह जलेन विमर्द्य च यामकं
लवणकाम्लजलेन विमिश्रितम् ।
उदितधातुगणस्य च मूषिकां
कुरु रसं विनिवेशय तच्च व ।
डमरुकाभिधयन्त्रवरेण तं
द्विदशयाममजाचयवर्जना ।
पवनपित्तकफक्षयकारकं
सकलरोगहरं परमं सदा ।

गजपतेर्बलवद्वलदो नृणां
 द्विजपतीक्षणवन्नयनप्रदः ।
 युवतिकामविलासविधायको
 भवति सूतवरः सुखदः सदा ।
 सघनसाररसः किल कान्तिद-
 स्वखिलकुष्ठहरः कथितो मया ॥

इति कर्पूररसः ॥

उदयभास्करनामरसो ह्ययं
 भवति रोगविधान्तकरः स्वयम् ।
 मगधिकामधुना सह गुञ्जिका-
 त्रयमितश्च सदा परिसेवितः ।
 ललितकामविलासविधायकः
 स्थविरकोऽपि रतौ तरुणायते ॥
 गदहरो बलदोऽपि हि वर्णदो
 भवति कर्मविपाकजरोगहा ।
 सकलसूतकशास्त्रविमन्यजो
 द्विजवरेण मया प्रकटीकृतः ॥

इति उदयभास्कररसः ॥

अथेदानीं प्रवक्ष्यामि धातुशोधनमारणम् ।
 अनुभूतं मया किञ्चित् किञ्चिच्छास्त्रानुसारतः ॥
 सुवर्णं रजतं चेति लोहं शुद्धमुदीरयेत् ।
 ताम्रं चैवाश्मसारञ्च नागवङ्गी तथैव च ॥
 तीक्ष्णलोहं निगदितं हितयं रसवेदिभिः ।
 समिश्रलोहचितयं सौराष्ट्ररीतिवत्तंकाः ।
 एतेऽष्टौ धातवो ज्ञेया लोहान्येवं भवन्ति हि ॥

अथ रसकगुणाः ।

द्विविधो रसकः प्रोक्तः कारवेज्जक-दुर्दरः¹ ।
 सत्त्वपाते परः प्रोक्तः प्रथमद्यौषधादिषु ॥
 स तु² मेहहरश्चैव पित्तश्लेष्मविनाशनः ।
 रञ्जनः पारदस्याथ नेत्ररोगक्षयापहः³ ॥

(1) The text reads कानी रज्जवदुर्दरः, which appears to be incorrect.

(2) The text reads सत्त्व, which seems to be incorrect.

(3) The second hemistich is wanting in the text.

We have adopted the reading of रञ्जवसमुच्चय.

पारदो रसकश्चैव देहलोहकरावुभौ ।
 नागार्जुनेन कथितौ सिद्धौ श्रेष्ठौ रसावुभौ ॥
 कृतौ येनाग्निसहनी सूतखर्परकौ शुभौ ।
 तेन स्वर्णमयी सिद्धिरर्जिता¹ च न संशयः ॥
 रसको द्रावितः सम्यक् निक्षिप्तो रसपूरके ।
 निर्मलत्वमवाप्नोति सप्तवारं निमज्जितः² ॥
 काञ्चिके वाय तक्ने वा नृमूत्रे³ मेघमूत्रके ।
 द्रावितं क्षालितं⁴ सम्यक् खर्परं परिशुध्यति ॥
 खर्परं रेचितं शुद्धं स्थापितं नरमूत्रके ।
 रत्नयेन्मासमेकं हि ताम्रं स्वर्णप्रभं वरम् ॥

(1) The text reads सिद्धौ राजिता, which is not accurate.

(2) The text reads निमज्जितं, which is incorrect.

(3) The text has only मूत्रे, which mars the metre.

(4) द्रावितं क्षालितं is the reading of the text, which is evidently an error.

वचाहरिद्रात्रिफला-गृहधूमैः ससेन्धदैः ।
 भस्मातकैष्टङ्गणैश्च चारैरान्धैश्च महितम्¹ ॥
 पादांशसंयुतैर्मूषां वृन्ताकफलसन्निभाम् ।
 निरुध्य शोषयित्वा च मूषामुखोपरि न्यसेत् ॥
 प्रधाते खर्परे ज्वाला सिता नीला भवेद्यदि ।
 लोहसंदंशके मूषां घृत्वा कृत्वा ह्यधोमुखीम् ॥
 भूम्यामाढालयेत् सत्त्वं यथानालं न भज्यते ।
 तदा सीसोपमं² सत्त्वं पतत्येव न संशयः ॥
 अनेनैव प्रकारेण वारचयकृते सति ।
 विनिःसरेत् सर्व्वसत्त्वं सहिंशु(?)गुरुणोदितम् ॥
 अथ सौराष्ट्रौगुणाः ।
 सौराष्ट्रदेशे सञ्जाता खनिजा³ तुवरी मता ।
 या लेपिता श्वेतवस्त्रे रङ्गबन्धकरी हि सा ॥

(1) The text reads वर्जितं, which seems to be incorrect.

(2) रसरत्नमुचय says वज्रामं. See Chap. II. Verse 161.]

(3) The text reads खनिता, which is incorrect.

फुल्लिका खटिका¹ तद्वत् द्विप्रकारा प्रशस्यते ।
 किञ्चित् पीता च सुस्निग्धा गरदोषविनाशिनी ॥
 श्वेतवर्णा परा साम्ना फुल्लिका लोहमारणी ॥
 कषाया मधुरा काङ्क्षी कटुका विषनाशिनी ।
 व्रणघ्नी कफहा चैव नेत्रव्यापत्तिदोषहा ॥
 कण्ठरोगहारा सा तु पारदे वोजजारणी ।
 धान्यास्त्रे तुवरी क्षिप्ता शुध्यति त्रिदिनेन वै ॥
 चारैरान्त्रैश्च मृदिता धाता सत्त्वं विमुञ्चति ।
 तत् सत्त्वं धातुवादार्थं शीघ्रं नोपपद्यते ॥

अथ पुटानि लिख्यन्ते ।

भूम्यां वै खन्यते गर्तं द्विहस्तं चतुरस्रकम् ।
 कृगणेन सहस्रेण पूरयेत्तदनन्तरम् ॥
 शीघ्रं धारयेन्मध्ये तदाच्छाद्य वनोपलैः ।
 सहस्रार्धेन वै सम्यग्वाङ्गं प्रज्वालयेत्ततः ॥
 महापुटमिदं प्रोक्तं ग्रन्थकारेण निर्मितम् ॥

इति महापुटम् ॥

(1) रसरत्नसमुच्चय says फट्कौ फुल्लिका.

एकहस्तप्रमाणं हि चतुरस्रं च गर्त्तकम् ।
 वनोपलसहस्रेण गर्त्तमध्यं च पूरितम् ॥
 मूषिकां चौषधेनाथ पूरितां तां तु मुद्रयेत् ।
 गर्त्तमध्ये निधाय गरीयानि¹ च निक्षिपेत् ॥
 ऊर्ध्वान्निं ज्वालयेत् सम्यक् सोऽयं गजपुटो भवेत् ॥
 इति गजपुटः ॥

उपलं पिष्टकं क्वाणमुत्पलञ्च गरीयकम् ।
 कृगणोपलसारौ च तचरा² कृगणाभिधाः ॥
 अरन्निमात्रे कुण्डे च वाराहपुटमुच्यते³ ॥
 इति वाराहपुटः ॥

वितस्तिदयमानेन गर्त्तं चेच्चतुरस्रकम्⁴
 कुक्कुटाख्यं पुटं विद्यादीपधानाञ्च साधनम् ॥
 इति कुक्कुटपुटः ॥

(1) रसरत्नसमुच्चय reads निरिण्डानि.

(2) रसरत्नसमुच्चय reads वराटी.

(3) The text reads अरन्निमात्रेण रुंधे च वाराहपुटमच्यते;
 which seems to be incorrect.

(4) The text reads गर्त्तं कुर्याच्चतुरस्रकं, which mars the
 metre.

छगणैरष्टभिः सम्यक् कपोतपुटमुच्यते ॥

इति कपोतपुटः ॥

तुषैर्वा गोवरैर्वापि रसभस्मप्रसाधनम् ।

माणिकाद्यमानेन गोवरं पुटमुच्यते ॥

इति गोवरपुटः ॥

मृदभाण्डे तु प्रपूर्वमेव मध्ये द्रव्यं तु विन्यसेत् ।

अधस्ताज्ज्वालयेदग्निं मृदभाण्डपुटमुच्यते ॥

इति (मृद)भाण्डपुटः ॥

गर्ते तु बालुकापूर्णे मध्ये द्रव्यं तु विन्यसेत् ।

उपरिष्ठादधस्ताच्च वज्रं कुर्यात् प्रयत्नतः ।

तदबालुकापुटं सम्यगुच्यते शास्त्रकोविदैः ॥

इति बालुकापुटः ॥

मूषिकां भूमिमध्ये तु स्थापितां द्वाङ्गुलादधः ।

उपरिष्ठात् पुटं दद्यात् तत् पुटं भूधराभिधम् ॥

इति भूधरापुटः ॥

(1) The text reads दक्षा, which is incorrect.

गोवरैर्वा तुषैर्वापि मात्राकर्षमितैः पुटम् ।

यत्र तन्नावकाख्यं स्थान्मृदुद्रव्यस्य साधने ॥

इति लावकापुटः ॥

इति श्रीपद्मनाभसूनुश्रीयशोधरविरचिते

रसप्रकाशसुधाकरे दशमोऽध्यायः ।

अथातः संप्रवक्ष्यामि धातूनां कौतुकं परम् ।

स्वानुभूतं मया किञ्चित् श्रुतं यच्छास्त्रतः खलु ॥

तदहं कथयिष्यामि यत् कृत्वा ना सुखी भवेत् ॥

रसकं दरदं ताप्यं गगनं कुनटीसमम् ।

रक्तसुहीपयोभिश्च मर्द्दयेद्दिनसप्तकम् ॥

जलयन्त्रेण वै पाच्यं चतुर्विंशतियामकम् ।

तेन वेध्यं द्रुतं ताम्रं तारं वा नागमेव वा ॥

सह(शत)वेधी तु तत्कल्को जायते नात्र संशयः ॥

एकभागस्तथा सूतो वज्रवज्रप्राथ मर्द्दितः ।

खले त्रिनिष्पाच्य रसे पञ्चभागसमन्विते ।

वेत्रयष्ट्या च रागिण्या पीतकल्कं प्रजायते ॥

षोडशंशेन दातव्यं द्रुते ताम्ब्रे सुशोभने ।

जायते प्रवरं हेम शुद्धं वर्णचतुर्दशम् ॥

इति हेमक्रिया ॥

स्वर्णमाक्षिकं संस्त्रोद्य काञ्चिके दिवसत्रयम् ।

चर्मरंग्या(गा)रसेनैव मर्दयेद्दिनसप्तकम् ।

जलेन धीतं तावच्च यावद्धेमनिभं भवेत् ॥

दरदं रसदेशीयं¹ गोमूत्रेणैव स्वेदयेत् ।

दोलायन्त्रेऽङ्गि² चत्वारि पञ्चाच्छुद्धतमो भवेत् ॥

मनःशिला पद्मनिभा रक्ता चैव सुशोभना ।

स्वेदिता मुनिपुष्पस्य रसेनैव तु दोलया ।

याममर्द्धमिता शुद्धा सर्वकार्येषु योजयेत् ॥

नवसारस्तथा सूतः शोधितोऽग्निमति स्थले ।

समभागानि सर्वाणि मर्दयेन्निम्बकारसैः ॥

मातुलुङ्गरसेनैव कुमारीसुरसेन वा ।

सूर्यातपे विमर्दोऽसौ पाचितो जलयन्त्रके ।

दिनानि त्रीणि तीव्राग्नी कुर्यात्तदवतारयेत् ॥

(1) The text reads रसदेशीयो, which is incorrect.

(2) अङ्गि [पद्मानि] is grammatically incorrect.

शतांशं वेधयेत्तारं शुद्धहेम प्रजायते ।

जलभेदो यदा न स्यान्नात्र कार्या विचारणा ॥

शिलया मारितं नागं कुमार्याः स्वरसेन तु ।

पुट्टादशयोगीन नागभस्म प्रजायते ॥

शतसंख्यानि वै कुर्यात् पुटान्येवं शरावके ।

कुमार्याः स्वरसेनैव भावयेद्दिनसप्तकम् ॥

पूर्ववत् पुटनं कार्यं शतसंख्यामितं तथा ।

सूतगन्धशिलादद्दुसमं चेन्नागभस्मकम् ।

त्रिंशदनोपलैर्दद्यात् पुटं वाराहसंज्ञकम् ॥

अनेन विधिना सम्यक् शतसंख्यानि दापयेत् ।

पुटान्येवं कृते त्रीणि शतानि द्वादशाधिकम् ॥

पद्याद्दृढे काचमये कूपे द्वात्रिंशयामकम् ।

वालुकाम्निं प्रदद्याच्च स्वाङ्गशीतं समुद्धरेत् ॥

तलभस्म ग्रहीतव्यं वेधयेत्तारशुद्धके ।

शुद्धहेम भवेत्तेन नात्र कार्या विचारणा ॥

दृष्टप्रत्यययोगोऽयं कथितो नात्र संशयः ॥

Extracts from RASACHINTAMANI.

मदनान्तदेवसूरिविरचितात् रसचिन्तामणेः
उद्धृताः श्लोकाः ।

सैश्वर्यं तोरिकां सूतं कासीसं लकुचद्रवैः ।
विष्टुष्य खल्वभाण्डस्यं सर्वश्लक्ष्णं दिनत्रयम् ॥ ७६ ॥
हृष्टिकायां तदारीष्य काष्ठवर्द्धिर्विधीयते ।
दिनत्रयेऽप्यतिक्रान्ते भस्म स्नेततरं भवेत् ॥ ७७ ॥

* * * * *

इति त्रयोदश भस्मसूतः ।

खर्परो द्वादशांशः स्यात् शिखिग्रीवं च तुल्यकं ।
षड्गुणं माक्षिकं नेत्रभागं ग्राह्यं मनःशिला^१ ।
भागत्रयमिदं ग्राह्यं शोभनागतकर्करैः^२ ॥ ७८ ॥

(1) अपि नेत्रभागा मनःशिला is the correct reading as stated in the margin of the text.

(2) त्रयो भागा अपि ग्राह्याः शोभना गतकर्करैः is the correct reading as stated in the margin of the text.

गंधकत्रयमेवास्ते काचमाचोरसैर्भृशं ।
 दिनसप्तात्र कर्त्तव्या भावना मर्दनं क्रमात् ॥ ३९ ॥
 अधोमुखेन यन्त्रेण तेन निःसारयेद्बुधः ।
 सत्वं तद्रसकस्याथ दृढं कार्य्यकरं परं ॥ ४० ॥
 अवश्यं तदृढं सत्वं निर्धूमं कर्मसाधनं ॥
 इति रसकसत्वपातनं ।

त्रिवारं गन्धकहतं ताम्रहेमद्वयत्रयं ।
 सत्वं तालस्य मासैकं योजयेत् सर्वकामदं ॥ ४३ ॥
 अभ्रवणे भवेहेमं ताम्रगंधकमारितं ।
 एतयोर्दीयते रस्यं जायते कांचनं शुभं ॥ ४४ ॥

इति श्रीमदनांतदेवविरचिते रसचिंतामणौ
 हेमीकरणप्रयोगः ॥

पारदं सौसकं गंधं कुनटी तच्चतुष्टयं ॥
 बीजपूरांभसा पिष्ट्वा बाढं दिनचतुष्टयं ॥ १०८ ॥
 अथ सूक्ष्माणि पत्राणि तेन तारस्य लेपयेत् ।
 बीजपूररसेनैतत् त्पुतिमात्राग्नितापितं ॥ १०९ ॥

एकाधिका भवंत्यत्र भावनाद्यास्य विंशति ।

विशोष्यावर्त्तितं तारं भवेत्तारस्य कांचनं ॥ ११० ॥

इति चिंतामणी हेमीकरणप्रयोगः ॥

हेमभागद्वयं तारं तथा तास्रं चतुष्टयं ।

एकतः क्रियते पञ्चमत्तिसूक्ष्मं निरामयं ॥ १११ ॥

जंवीरनीरसंपिष्टं स्वर्परस्याष्टटंकणं ।

तेन तान्यथ पत्राणि लेपनीयानि वै बहु ॥ ११२ ॥

आवर्त्तते पुनर्दत्त्वा मृषके गलितानि च ।

तदा तानि भवंत्यत्र हेमरूपाणि नान्यथा ॥ ११३ ॥

इति हेमीकरणप्रयोगः ॥

एकभागी भवेदारः तारं भागद्वयं भवेत् ।

वेदभागं भवेत्तीक्ष्णं सत्त्वं सत्वाच्च वै दश ।

वंगभागं भवेत्पत्रं सर्वमेकत्र कारयेत् ॥ १०८ ॥

टंकणेन पुनः धातं पत्रं कृत्वास्य वक्तृगं ।

वेलाचयमिदं धातं तत्क्रमध्ये निवेशयेत् ॥ ११० ॥

एवं तारं भवेन्नूनं परीक्षाक्षममापणे ॥

इति तारोत्पादकं ॥

तुत्यकं पिथ्यते खले त्रिफलाङ्गुलकणैः ।

मध्वाज्यमिश्रितं धातं सत्त्वं पातयते ध्रुवं ॥ ६८ ॥

इति तुत्यकसत्त्वपातनं ॥

खर्परः स्वेद्यते पूर्वं कौलत्येन जलेन च ।

वटारोहजलेनापि पर्णचूर्णेन शोभनः ॥ ७५ ॥

गुडटंकणसंमिश्रस्त्रिफलाक्वाथमर्दितः ।

मृन्मये कूपके कृत्वा धाम्यमानो भृशं च सः ॥ ७६ ॥

श्वेतधूमोद्गमे जाते तत उत्थाप्य कूपकं ।

सावधानं करेणैव भूमौ तं चाध आनयेत् ॥ ७७ ॥

पुनश्च धाम्यते कूपः तथाजातं च तं पुनः ।

कूपकं च पुनर्भूमौ तथा तं नामयेत् पुनः ॥ ७८ ॥

सत्त्वं खर्परकस्यैतत् नागरूपं पतत्यधः ॥ ७९ ॥

इति खर्परसत्त्वपातनं ॥

Extracts from RASAKALPA.

रुद्रयामलान्तर्गतात् रसकल्पादुद्धृताः
श्लोकाः ।

शिवं नत्वा रसाधीशं चण्डिकाचरणं तथा ।
क्रियते^१ रसकल्पोऽयं रसज्ञानविशारदः^२ ॥ १ ॥

—
॥ अथ परीक्षा ॥

अतेजा अगुरुः शुभ्रो लोहहा(ऽ)चक्षुलो रसः^३ ।
यदा^४ नावार्त्तयेद्दृष्टौ नोहं गच्छेत्तदा मृतः ॥ ४० ॥

(1) The text reads करीमि, which is grammatically incorrect.

(2) The reading in the text is विशारदम्, which is incorrect.

(3) The text reads रस, which is incorrect.

(4) The text reads यदामावर्त्तयेत्, which is not correct.

दन्ते शृङ्गे मणौ वेणौ रक्षयेत् साधितं रसम् ॥ ४२ ॥

इति श्रीरुद्रयामले रससंकेतकं नाम

प्रथमोक्तासः ।

हेमरूप्याकंवङ्गाहि'लौहा लोहाः' षड्वीरिताः ।

अकृत्रिमा इमे येषां वर्त्ताद्याः स्युस्तु' कृत्रिमाः ॥ १ ॥

सन्तो वडाञ्जलिपुटो युष्मान् विज्ञापयाम्यहम् ।

कृपासुधारसयुता दृष्टिर्गन्धे प्रदीयताम् ॥

महारसाः स्युस्तत्रादावष्टौ पारदहिङ्गुले ।

वैष्णवं शस्यकं शैलं चपलं रसकोऽमलम् ॥

(महारसाः)

(1) The text reads वङ्गाहिः, which is grammatically incorrect.

(2) लोहिलौहा is the reading of the text, which seems to be incorrect.

(3) The text reads रीवात्तादासुकृतिमा, which is palpably an error.

अभ्रकं तुल्यकं कान्तं राजावर्त्तमथाञ्जनम् ।

वज्रं वेक्रान्तकं चैव टङ्कणं च रसा बहु ॥

(रसाः)

गन्धकं तालकशिले क्षितिस्त्रैचरगैरिकाः ।

इत्यादयश्चोपरसाः सर्वाचार्यैरुदीरिताः ॥

(उपरसाः)

सितासितारुणं पीतं गन्धकं तच्चतुर्विधम् ॥

तालकं द्विप्रकारं स्यात् गोदन्तः पाटलच्छविः¹ ॥

रक्ता पीता शिला द्वेधा पूर्व्वेऽथेष्टोत्तराधमा² ॥

बहुप्रकारा सौराष्ट्री कासीसं त्रिविधं मतम्³ ॥

कासीसं पुष्पकासीसं हीरकासीसमित्यथ ॥

गैरिको द्विविधः प्रोक्तः सौवर्णो लोहितस्तथा ॥

(1) The text reads पटलच्छवि, which seems to be incorrect.

(2) पूर्वा अष्टोत्तराधमा is the reading of the text, which is incorrect.

(3) The text reads कासीसस्त्रिविधी मतः, which is incorrect as it is mentioned neuter in the next line.

कङ्कुठादीन्¹ रसान् केचिदचार्वा वर्णयन्ति वै ।
अस्माभिरिह तन्नोक्तं मुनिमार्गानुसारिभिः ॥

इत्येष प्रोदितो मार्गो रसशोधनकर्मणि ।
स्वच्छन्दभैरवाद्युक्तो गोविन्दादिसमाहृतः² ॥

लवणं चूलिकोद्धृतं गन्धकेन समन्वितम् ।
सर्वाङ्गदक्ष³ चित्राद्रे मूलभस्मप्रगालितम् ॥
गोमूत्रेण शतं भाग्यं तद्रसे जारयेत् शनौ⁴ ।
तस्य संपर्कतः सूतो राक्षसो भवति ध्रुवम् ॥

(1) The text reads कङ्कुठादीन्, which is an error of the scribe

(2) The text reads रुमादितः, which is incorrect.

(3) The text reads सर्वाङ्गदक्ष, which seems to be incorrect.

(4) शनिः, as given in the text, is grammatically incorrect.

एतदेव विडं दद्यात् सर्व्वदा हेमजारणे¹ ।

मुखं संजायते तेन जोर्य्यते च² विनिश्चितम् ॥

इति श्रीरुद्रयामले रसकल्पे उमामहेश्वरसंवादे

रसशोधनप्रकारः ॥

इति संधानयोगोऽयं जारणेऽतिगुणावहः ॥

प्रकाशितः संप्रदायक्रमप्राप्तः शिवोदितः ॥

इति श्रीरुद्रयामले रसकल्पे उमामहेश्वरसंवादे

रसाधिकरणो³ नाम द्वितीयोक्तासः ॥

महारसानां सर्व्वेषां रसानां शुद्धिरुच्यते ।

तथैवोपरसानाञ्च शास्त्रदृष्टेन वर्त्मना ॥ १ ॥

कदलीपत्रजैर्नीरैः माक्षीकं भावयेत् शतम्⁴ ।

गन्धर्वतैलमध्वाज्य-पक्वमेकं दिनत्रयम् ॥

(1) The text reads हेमजारणौ, which is not correct.

(2) The text reads न, which appears to be an error.

(3) The text reads रसाधिकारिणा, which is incorrect.

(4) The text reads शलं, which is senseless.

तत्ताप्यं वज्रमूषायां¹ पक्तायां निक्षिपेत्ततः ।
लोहसम्भानकरणं तत्समं तत्र निष्यचेत् ॥
दृढां प्रकल्पयेन्मूषां² कोष्ठिके³ विनिवेशयेत् ।
अङ्गारैः खदिरोद्भूतैः धमेदुभस्त्राद्वयेन वे ॥
वक्रनालयुजा सत्त्वं ताप्यस्य पतति ध्रुवम् ॥
शुक्लदीप्तिः सशब्दश्च⁴ यदा वैज्ञानरो भवेत् ।
तदा सत्त्वं तु पतितं जानीयान्मान्यथा क्वचित् ॥

रसकं स्वेदयेदादौ⁵ पटुचूर्णं कृतं बुधः ।
चतुर्गुणेन वस्त्रेण दृढं बध्वा च डोलिकाम् ॥

(1) तत्ताप्यं वज्रमूषा is the reading of the text, which appears to be incorrect.

(2) The text प्रकल्पयेन्मूषा is evidently incorrect.

(3) कोष्ठिकानि निवेशयेत् is the reading of the text, which has no meaning at all.

(4) The text reads सशब्दश्च, which is grammatically incorrect.

(5) रसकादस्वेदयेदादौ is the reading of the text, which seems to be incorrect.

कृत्वा भाण्डे च सजले¹ स्वेदयेन्मासपञ्चकम् ।
 उद्धृत्य पश्चाद्रसकं खल्लमध्ये² विचूर्णयेत् ॥
 पाद्रीशान् मालतीजातं सगुडं जीर्णगुञ्जकम् ॥
 गृहधूमं रेवकीं च निशामं कुङ्गजीरकान्³ ॥
 तत् सर्वं चूर्णितं कृत्वा गोपंचकविभावितम् ।
 कृत्वा तद्वटिकाः पश्चात् छायायां शोषयेत्ततः ॥
 कोष्ठगेनाग्निना⁴ पश्चाद्वमेदुभस्त्राद्वयानिलैः ।
 सत्त्वं पतत्यसंदेहं स्थिररङ्गं दृढं बहु ॥
 एकमासं द्विमासं वा रसकं स्वेदितं यदि ।
 न धातव्यं तच्च कोष्ठे धमेत्तत् नालमूषया ॥

—

इति सम्पादितो मार्गी द्रुतीनां पातने स्फुटः ।
 साक्षादनुभवैर्दृष्टो न श्रुतो गुरुदर्शितः ॥

(1) कृत्वा भाण्डेन सजले is the reading of the text, which is incorrect.

(2) The text reads खल्लमध्ये.

(3) The text has जीरका, which is grammatically incorrect.

(4) The text reads कोष्ठकेनाग्निना, which is not correct.

लोकानामुपकाराय एतत् सर्वं निवेदितम् ।
 सर्वेषां चैव लोहानां द्रावणं परिकीर्तितम् ॥
 इति श्रीरुद्रयामले रसकल्पे उमामहेश्वरसंवादे
 सर्वलोहद्रुतिपातनाधिकारः समाप्तः¹ ॥

Extracts from RASARAJALAKSHMI.

विष्णुदेवविरचितायाः रसरजलक्ष्म्याः

प्रारम्भः—

यस्येच्छाङ्गुरवक्त्ररो मुकुलिता नानाकलाकौतुकैः
 चातुर्यैकविलोलपल्लववती कीर्त्तिप्रसूनप्रसूः ।

(1) समाप्तं ग्रन्थम् is the reading of the text, which is not correct.

संनिर्वापयति ज्वरत्रयमहो च्छायाकलापैर्नृणां
सोऽयं पातु विचारमूर्तिरखिलं कालापलौढं जगत् ॥१॥

जयति दुरितसर्पस्तोडमंत्रोद्यदपः
प्रबलगदविनाशः सेविविध्वस्तनाशः ।
शिव इव विज(बीज ?)मंत्रः संहितायोगमंत्रः
त्रिपुरहरतनूजस्तेजसः कायपुंजः ॥ २ ॥

इति श्रीपण्डितमहादेवतनयश्रीविष्णुदेवविरचितायां
रसराजलक्ष्म्यामुक्तासः प्रथमः ॥

दृष्ट्वेमं रससागरं शिवकृतं श्रीकाकचण्डेश्वरी-
तन्त्रं सूतमहोदधिं रससुधान्धोधिं भवानीमतम् ।
व्याडिं सुश्रुतसूत्रमीशद्वयं स्वच्छंदशक्त्यागमं
श्रीदामोदरवासुदेवभगवद्गोविन्दनागार्जनान् ॥

प्रथमः उक्तासः ।

स्वच्छंदशक्त्यागमसारभूतः

समुद्धृतो विष्णुभिषग्वरेण ॥ ११० ॥

द्वितीयः उक्तासः ।

आलोक्य सुष्ठुतं वृन्दहारीतचरकादिकान् ।
आत्रेयं वाम्भटं सिद्धसारं दामोदरं गुरुम् ॥

तृतीयः उक्तासः ।*

* Foll. 1—43. Linn. 10. Rasarājalakshmīs, de medicamentis metallorum et fossilium ope conficiendis liber, a Rāmes'vara (bhāṭṭa), Viṣṇus filio, compositus. Incipit : आनन्देकरसे विकल्पकलनानिमुञ्जबोधात्मकं प्रारम्भावधिसंगति-
व्यपमते etc. ॥ १ ॥ स्वशिशुखीमंघनमंघनेन (1. स्वशिशुखी) sphurad Rasāmbhodhi-gabhīragarbhāt । s'ri-Viṣṇudevi (o devī) labhate prayatnāt s'ri Viṣṇuvatsād Rasarājalakshmīm ॥ 2 ॥ Drishtvēmam Rasasāgaram, S'ivakṛitam s'ri-Karka-
chandes'varītantram, Sūtamahodadhim, Rasasudhām-
bhodhim, Bhavānīmatam, Vyādi[m]. Sus'rutasūtram,
Is'ahṛidayam, Svachobhandas'aktyāgamam, s'ri-Dāmoda-
ra-Vāsudeva-Bhagavad-Govinda-Nāgārjunān ॥ 3 ॥ आनन्द-
मानन्दकरं प्रसन्नं आनन्दरूपं निजभाषयुक्तम् । योगैर्द्रवीयं भवरीगवैयं
श्रीमद्गुरुं नित्यमहं नमामि ॥ ४ ॥

महारसाः सुस्तवादावष्टौ पारदर्शिन्युते ।

वेषावं सुखकं शैलं अपलं रसकोमलम् ॥ ५ ॥

अमकं तुल्यकं (tutthakam) कान्तं राजावर्त्ममयाजितं ।

वय्यकैकान्तिकं (o vaikrāntakam) चित्ति टंक्यं च रसान्विदुः ॥ ६ ॥

तालकं गंधकशिलै चित्तिचिखरगैरिकाः ।

इत्यादयद्योपरताः पूर्वाचार्यैरुदीरिताः ॥ ७ ॥

Aufrecht's "Catalogus," p. 321, No. 761.

Colophon at the end of the Rasarájalakshmi—

राजन् (सश)शार्वरिवत्सराद्यदिवसे वारि हिमांशोरिदं
चंचदभूतलपत्तने विजयिनि श्रीबुक्कपृथ्वीपतेः ।
शास्त्रं वैद्यकसाररूपमकरोत् श्रीविष्णुदेवः कविः
वाग्देवीचरणारविंदमकरंदामोदसौरस्यवाक् ॥

Extracts from RASANAKSHATRAMALIKA

मथनसिंहविरचितायाः रसनक्षत्रमालिकायाः

उद्धृताः श्लोकाः ।

चतुश्चतुःशंखकपर्दिकानां
सतक्रजम्बीरविमर्दितानाम् ।
आफेनमाक्षीकविषद्वयानां
पलं पलं दन्तिफलान्वितानाम् ॥ २५ ॥

यतभस्मगन्धसूता द्वितयं वङ्गस्य शुद्धतीक्ष्णस्य ।
 दग्ध्वा मृगस्य शृङ्गं त्रिगुणं दत्त्वा रसार्द्धविषम् ॥ १२३ ॥
 चिचकशोतशिवावृषदशमूलदिवनदविल्वगिरैः ।
 कलहत्तारविकृतकैः प्रत्येकं भावनत्रितयम् ॥ १२४ ॥
 दत्त्वा सुसिद्धमात्रो मारिचधूपेन धूपितः सम्यक् ।
 स्वच्छन्दभैरवाख्यो रसः समस्तामयध्वंसो ॥ १२५ ॥
 चिकटुकरसेन युक्तो विशेषतः सन्निपातहरः ।
 ग्रहणिगदामयशूलव्रणविद्रधिवातगुल्मजयी ॥ १२६ ॥
 इति स्वच्छन्दभैरवो रसः ॥*

इयं मालविभूपालभिषजा भिषजां मता ॥
 कृता मथनसिंहेन रसनक्षत्रमालिका ॥ १४२ ॥

इति रसनक्षत्रमालिका समाप्ता ॥ स्वस्ति
 संवत् १५५० आश्विन कृष्ण ५ सोमे ।

* The स्वच्छन्दभैरव रस mentioned in the रसनक्षत्र-
 मालिका is quite distinct from that, which is stated in
 the रसेन्द्रचिन्तामणि. Neither has it any analogy with
 what is described in the रसरत्नसमुच्चय.

Extracts from RASARATNAKAR

नित्यनाथविरचितात् रसरत्नाकरात्

उद्धृताः श्लोकाः ।

यदुक्तं शम्भुना पूर्वं रसखण्डे रसार्णवे ।
रसस्य वन्दनार्थं च दीपिकारसमङ्गले ॥
व्याधितानां हितार्थाय प्रोक्तं नागार्जुनेन यत् ।
उक्तं चर्पटिसिद्धेन¹ स्वर्गवैद्यकपालिके ।
अनेकरसशास्त्रेषु संहितास्वागमेषु च ।
यदुक्तं वाभटे तन्त्रे सुश्रुते वैद्यसागरे ॥
अन्येषु बहुभिः सिद्धैः यदुक्तञ्च विलोक्य तत् ।
तत्र यदयदसाध्यं स्यादयदयदुद्गममौषधम् ॥
तत्तत् सर्वं परित्यज्य सारभूतं समुद्धृतम् ॥
क्वचिच्छास्त्रे क्रिया नास्ति क्रमश्चापि न च क्वचित् ।

(1) चर्पटिसिद्धेन is the reading in the Sanskrit college MS.

मात्रायुक्तिः क्वचिन्नास्ति सम्प्रदायो न च क्वचित् ।
 तेन सिद्धिर्न तत्रास्ति रसे वाथ रसायने ॥
 वैद्ये वादे प्रयोगे च तस्मादयन्नो मया कृतः ॥
 यदयदगुरुमुखाज्ज्ञातं स्वानुभूतञ्च यन्मया ।
 तत्तल्लोकहितार्थाय प्रकटीक्रियतेऽधुना ॥

प्रथमोपदेशे ।

इति श्रौपार्व्वीतोपुत्तनित्यनाथसिद्धविरचिते रसरत्नाकरे
 रसखण्डे रसपीठिका नाम प्रथमोपदेशः ।

परीक्षा मारिते कृते कर्त्तव्या च यथोदिता ।
 अधस्तुषाम्निना तप्तो ह्यक्षौणस्तिष्ठते यदा ।
 तदा भस्म विजानीयाच्चुङ्गां यामं निरौक्षयेत् ॥
 तृतीयोपदेशे ।

दन्ते शृङ्गेऽथवा वंशे रक्षयेत् साधितं रसम् ॥
 चतुर्थोपदेशे ।

अथातः शुद्धसूतस्य मूर्च्छनाविधिरुच्यते ।
 मेघनादावचाहिङ्गुशूरणैर्मर्हयेद्रसम् ॥

नष्टपिष्टन्तु तद्गोलं हिङ्गुना विष्टयेद्वह्निः ।
 पचेन्नवणयन्त्रस्थं दिनैकं चण्डवज्जिना ॥
 ऊर्ध्वलम्नं समादाय दृढं वस्त्रेण बन्धयेत् ।
 ऊर्ध्वाधो गन्धकं तुल्यं दत्त्वा सोमानले पचेत् ॥
 जीर्णं गन्धे पुनर्देयं षड्भिर्वारैः समं समम् ।
 षड्गुणे गन्धके जीर्णं मूर्च्छितो रोगहा भवेत् ॥
 चतुर्थोपदेशे ।

Extracts from DHATURATNAMALA.

धातुरत्नमालायाः

प्रारम्भः—

प्रणम्य विततीं शक्तिं त्रिसृष्ट्युत्पत्तिकारिणीं ।
 धातूनां रत्नमालायामभिधायं करोम्यहं ॥ १ ॥
 ब्रह्मविष्णुहराद्यान् ये मर्त्ता ध्यायन्ति नित्यशः ।
 ज्ञानदानप्रदानाय सा मे विश्वेश्वरी मता ॥ २ ॥

अथ धातूनां रत्नमालां वक्ष्यामि ।

रौप्यं हेमं तथा ताम्रं नागं वंगं तथायसं ।

खर्पराभ्रकमौक्तं च प्रवालं तालकं शिला ॥ ३ ॥

सुवर्णमाक्षिकं सूतं हीरकं च ब्रवीम्यहं ।

सर्वधातूपधातूनां लक्षणं मारणं गुणं ॥ ४ ॥

अथ रौप्यमारणं ।

रौप्यं शुद्धं समादाय नागिन गुरु शोधयेत् ।

शुद्धे तारे पुनः पश्चात् सूक्ष्मपत्राणि कारयेत् ॥ ५ ॥

निंबचिंचिणिद्राक्षाभिः शोधयेच्च पृथक् पृथक् ।

चालयेदुदकैः साहं तथा दुग्धेन शोधयेत् ॥ ६ ॥

गंधपारदयोरेकं किंचिद्वंगं च घर्षयेत् ।

द्राक्षाया द्रवसंयुक्तं तारपत्राणि शोधयेत् ॥ ७ ॥

चक्रयन्त्रे विनिक्षिप्य लेपयेद्वस्त्रमृत्तिकां ।

क्षिपेद्गजपुटे गर्त्ते ज्वालयेद्बहुक्कानकान् ॥ ८ ॥

समाप्ति :—

ग्रंथो वैद्यकनामायं रससिद्धांतसागरात् ।

धातूनां रत्नमाला च ततो वैद्यस्य हेतवे ॥ १०६ ॥

मरणेभ्यो भयवस्ता रोगग्रस्ताश्च ये नराः ।

रत्नमाला कृता तेषां वैद्यानां च हिताय वै ॥ १७७ ॥

इति श्रीवैद्यकशास्त्रे अश्विनीकुमारसंहितायां

धातुरत्नमालायां समाप्तोऽयं ग्रंथः ॥

The following is taken from Aufrecht's
"Catalogus"—No. 760.

Incipit :—प्रणम्य सारदां शक्तिं सृष्टेरुत्पत्ति-
कारकां । धातूनां रत्नमालां च विबोधाय करोम्यहं
॥ १ ॥ ब्रह्माविष्णुहरान् ध्यायेद्ब्रह्मा ध्यायन्ति नित्यशः ।
तेषां वरप्रदानाच्च सा मयैवमुदीर्यते ॥ २ ॥ रूप्यं
हेम तथा ताम्रं नागं वंगं तथायसं । खर्परं गगनं
प्रोक्तं प्रवालं तालकं शिला ॥ ३ ॥ मादिकं गंधकं
सूतं हीरकं च ब्रवीम्यहं । सर्वधातूपधातूनां लक्षणं
मारणं गणान् ॥ ४ ॥ रूप्यं शुद्धं समानीय नाग-
मूषा नु शोधयेत् । शुद्धे तारि पुनः पद्मात् सूक्ष्म-
पत्राणि कारयेत् ॥ ५ ॥ निंबुचिंचिणीद्राक्षाभिः शोधनीयं
पृथक् पृथक् । जालयेद्दुदकैः साहं तथा दुग्धेन
शोधयेत् ॥ ६ ॥ गंधकं पारदं रूप्यं किंचिद्वंगं च

घर्षयेत् । द्राक्षारसेन संयुक्तं तारपत्राणि लेपयेत्
॥ ७ ॥ नक्तं यन्त्रे विनिक्षिप्य लेपयेद्वस्त्रमृत्तिकां ।
क्षेप्यं गजपुटे गर्त्ते ज्वालयेच्च ग्रहोपलैः ॥ ८ ॥

In fine libelli disticha haec leguntur :

ग्रंथो वैद्य [क] नामायं Rasasiddhāntasāgarāt ।

धातूनां रत्नमाला च कृता वैद्यसुहेतवे ॥ १ ॥

मरणेभ्यो भयत्रस्ता रोगग्रस्ताश्च ये नराः ।

रत्नमाला हि धातूनां कृता तेषां हिताय वै ॥ २ ॥

Jātyā Gurjarakhandas cha, Devadatto

hi dharmavit ।

Harer nāmābhidhānasya सुतस्तस्य भिषग्वरः ॥ ३ ॥

संहितारसकर्माणि यस्य बुद्धिर्गरीयसी ।

तेन शास्त्रविधिज्ञेन कृता रत्नस्य मालिका ॥ ४ ॥

इति देवदत्तकृतवैद्यकशास्त्रे धातुरत्नमाला ॥

Extracts from RASAPRADIPA.

रसप्रदीपादुद्धृताः श्लोकाः ।

A—MS. from Alahabad.

B—MS. from Benares.

अथ शङ्खद्रावरसः ।

स्फटिका¹ नवसारस्य सुखेता² च सुवर्चिका ।
पृथक् दशपल्लोन्मानं गन्धकः पिचुसंमितः³ ॥
चूर्णयित्वा क्षिपेद्वाण्डे मृन्मये मृद्विलेपिते⁴ ।
तन्मुखं मुद्रयेत् सम्यक् मृदभाण्डेनापरेण च ॥
सरन्ध्रोदरकेणैव चुक्रां तिर्यक् च धारयेत् ।
अधः प्रज्वालयेद्दङ्गिं हठाद्यावद्रसः स्रवेत् ॥

(1) A reads स्फटिका, B. reads स्फुटिका.

(2) B reads सुसेता, which is not correct.

(3) B reads पिसंमिचुतः, which is not correct.

(4) मृध्नि¹ लेपिते is the reading in B.

शाणैकं सेवयेद्यत्नात्¹ दन्तस्पर्शविवर्जितम् ।
 गुल्मीदरयुक्तप्लीहग्रन्थिघ्न्यादिशूलनुत् ॥
 बलपुष्टिप्रदो ह्येष भुक्तं च जारयेत् क्षणात् ।
 विलोक्यतां महालोका रसमाहात्म्यमद्भुतम् ।
 कपर्दकाद्य लोहानां यस्मिन् चित्ता² गलन्ति हि ॥

फिरङ्गव्याधिः—

गैरिकं रसकर्पूरम् उपला च पृथक् पृथक् ।
 टङ्कमात्रं विनिष्पिष्य³ ताम्बूलोदलजैः रसैः ॥
 वयस्यतुर्दशास्तेषां⁴ कर्त्तव्या भिषगुत्तमैः⁵ ।
 सायं प्रातः समश्नीयात्⁶ एकैकां दिनसप्तकम्⁷ ॥

- (1) B reads यन्तु.
- (2) A reads चित्ता.
- (3) A reads विनिःस्पिष्य.
- (4) A reads चतुर्दशैस्तेषां. B reads चतुर्दशस्तेषां.
- (5) B reads भिषगौत्तमौ, which is incorrect.
- (6) B reads समश्नीयात्, which is incorrect.
- (7) दिनसप्तकं an incorrect variant in B.

सष्टता योन्निका' देया भोजनाय निरन्तरम् ।
फिरङ्गव्याधिनाशाय वटिकेयमनुत्तमा ॥ *

(1) गोधूमरोटिका इत्यर्थः.

* The following is taken from योगतरङ्गिणी of Tri-mallabhatta, printed in Bombay in the S'aka year 1810.

यंवे सुविष्टे डमरुसमाख्ये
निधाय सूतस्य पलानि पंच ।
वल्मीकसत्खाखटिकेटिकानां
समैरिकानां तुवरैयुतानाम् ॥ ६० ॥
सर्पेधवानां समभागिकानां
चूर्णादकं चोपरितो निदध्यात् ।
अस्मेन दद्याद् महिषीभवेन
पिष्टं रसीनस्य शरावमेकम् ॥ ८१ ॥
समक्रमेणाव निधाय ख'डे-
राच्छादयेत् ख'परजैर्विसंधि ।
चूर्णप्रलिप्तोदरमूर्ध्वभाजं
संख्याप्य संमुद्रा डडं सुचुल्लाम् ॥ ६२ ॥
प्रज्वालयेदग्निमधः क्रमेण
संख्याप्य यंचोपरि बस्त्रमार्द्रम् ।
वहि' प्रदद्याद्दिनपट्वमव
तत् स्वाङ्गशीतं परिमृज्य सुखा ॥ ६३ ॥

चन्द्रोदयाख्य रसवर्णने—

काशे श्वासि फिरङ्गाख्ये रोगे च परमो हितः ।

अथ उपायान्तरम्—

मुशल्या^१ कुलकञ्चैव^२ पारसीकयमानिका ।

भक्तातकफलं चापि पलमानं पृथक् पृथक् ॥

तं द्रोणपुष्पीपयसा प्रपिष्टं

कृष्णं विदध्यान्नवसादरं च ।

कर्षप्रमाणं प्रहरण्यं च

वज्रं प्रदद्यादथ शीतलाग्नीम् ॥ ६४ ॥

निष्कास्य कृपीं सिकताख्ययवा-

दास्तीव्य कठस्थनमुं प्रगृह्यात् ।

कपूर्वनामा रसनायकोऽयं

वज्रः पुराणेषु गुडेन भुजः ॥ ६५ ॥

निर्वातभाजा मुखजा च पण्य-

शीलेन कुष्ठामयनाशनः स्नात् ॥

फिरङ्गकरिकेशरी सकलकुष्ठकालानलो-

ऽस्त्रिलज्जयविनाशकदृज्जयजगत्पूषिन्द्रः ।

सुवर्णसमवर्णं ज्वलपुताग्रतेजस्करः

समस्तगदतस्करो रसपतिः स कर्पूरकः ॥ ६६ ॥

इति कर्पूररसः बौद्धसर्वज्ञसात् ।

(1) B reads मुशङ्गा.

(2) B reads कलकं चेत् ।

पलार्द्धमानः सूतः स्यात् षट्पलोऽत्र गुडः स्मृतः ।
 एकीकृत्याखिलं कुर्यात् वटीः कर्षप्रमाणतः ॥
 खादेदेकां वटीं प्रातर्यावदारोग्यदर्शनम् ।
 गोदध्नश्चानुपानेन फिरङ्गामयनाशिनौ^१ ॥
 निम्बुकेन^२ विना नैव वर्जनोयमिहापरम् ॥

अथ उपायान्तरम्—

चोपचीनीभवं चूर्णं शाणमानं समाक्षिकम् ॥
 फिरङ्गव्याधिनाशाय भक्षयेत्तवणं त्यजेत् ॥

(1) B reads फिरङ्गापविनाशिनौ.

(2) B reads निम्बुकेन.

Extracts from DHATUKRIYA or DHATUMANJARI.

रुद्रयामले धातुक्रिया धातुमञ्जरी वा । *

श्रीगणेशाय नमः ।

पार्वत्युवाच ।

अथानन्तरं^१ देवेश ब्रूहि धातुसंस्कृतिम्^२ ।

येन विज्ञानमात्रेण साधयेद्भातुसंज्ञितः ॥ १ ॥

महादेव उवाच ।

धातुस्तुर्यविधः प्रोक्तः तुर्यस्तुर्यं स्वपक्षतः (?)^३ ।

सत्त्वं रजस्तमश्चैव चतुर्थस्तु निरामयः ॥ २ ॥

* The Ulwar MS. (A) reads धातुक्रिया, a part of the Rudrayāmala ; but the Benares MS. (B) reads धातुमञ्जरी, a part of the same. The two MSS. are exactly the same in subject matter, differing only in name.

(1) A reads अथानन्तर, which is grammatically incorrect.

(2) A reads धातुसंस्कृति, which is grossly incorrect.

(3) The sense here is not clear.

राजसे राजसी सिद्धिस्तामसे तामसी सदा ।

सत्त्वसाधनं सात्त्विके आनीते^१ सर्वसाधनम् ॥ ३ ॥

पार्वत्युवाच ।

कथ्यतां देवदेवेश सत्त्वं राजसतामसम् ।

अतीव गुणवत्^२ धातोः कार्यं लक्षणलक्षितम्^३ ॥ ४ ॥

उपधातुक्रमेणैव तेषां लक्षणसाधनम् ।

विट्को च मुदा युक्ता तेषां कर्मसु^४ साधनम् ॥ ५ ॥

उपकारो^५ गुणलक्षं नाना कार्यक्रिया शुभा ।

वियोगयोगचाञ्चल्यं वर्णभेदेस्तु मारणम् ॥ ६ ॥

समग्रं देवदेवेश विशेषा धातुक्तक्रियाः ।

येन विज्ञानमात्रेण साधयेत् गन्धकीः क्रियाः ॥ ७ ॥

(1) A reads अनौते, which seems to be incorrect.

(2) A has गुणवती, which appears to be incorrect.

(3) कार्या लक्षणलक्षिताः, a variant in A, which is not correct.

(4) A reads erroneously कर्मसु.

(5) A reads उपकारं, which is grammatically incorrect.

महादेव उवाच ।

पृथिव्या गर्भमध्ये तु अनेका धातुस्तिष्ठति^१ ।

विस्तृता^२ कियत्कालेन धातुर्नानाविधोदिता^३ ॥ ८ ॥

गुणलक्षणसंयुक्ता^४ साम्प्रतं न स्मरामि ह^५ ।

कथं ते कथयिष्यामि^६ वद ब्रह्माण्डवासिनि ॥ ९ ॥

पार्वत्युवाच ।

ये केचित् स्मर्यन्त^७ ईश व्यक्तं कथय साम्प्रतम् ।

भवतो^८ऽनुग्रहेणैव साधनार्थं^९ सिध्यति ॥ १० ॥

(1) अनेका धातु तिष्ठति, a variant in A, which treats the word धातु in the neuter as well as in the feminine genders.

(2) A reads विकृता, which is not correct.

(3) धातुनानाविधोदिता, an incorrect variant in A.

(4) A reads संयुक्ता, which is grammatically incorrect.

(5) A reads स्मरति ह, which is incorrect.

(6) कथयामास is the incorrect reading in A.

(7) A and B read स्मरन्ते, which is grammatically incorrect.

(8) भवता is the reading in A and B, which is not correct.

(9) साधनार्थं is the incorrect reading in A and B.

महादेव उवाच ।

शृणु देवि प्रवक्ष्यामि धातुं नानाविधस्थितिम् ।

गुणलक्षणसंयुक्तां यथा बुद्धिः^१ कथिष्यति ॥ ११ ॥

मुख्यप्राधान्यता^२ एते रङ्गलोहक^३ताम्रकैः ।

रजतेनैव^४ संयुक्ता धातोरुत्तमता सदा ॥ १२ ॥

मध्यमा सत्त्वजा धातुः^५ नीचा च त्रपुसीसयोः ।

संयोगे धातुनामा हि नीचा नीचतरा स्मृता ॥ १३ ॥

संयोगान्ते त्रिधा प्रोक्ता उत्तमा मध्यमाधमा ।

ताम्रजासत्त्वयोर्योगि^६ नारीधातुः प्रजायते ॥ १४ ॥

(1) A and B read बुद्धिः

(2) मुख्यप्राधान्यता is the correct reading. प्राधान्यता is grammatically incorrect.

(3) A and B have रङ्गलोहकताम्रकैः, which mars the metre.

(4) A reads रजतेनैव, which is not correct.

(5) धातुः is used here in the feminine gender both by A and B.

(6) Vide verse 20.

एषा^१ मध्योत्तमा प्रोक्ता कार्यकारणयोगके ।
 त्रपुताम्बसंयोगेन^२ जाता धातुश्च मध्यमा ॥ १५ ॥
 सीसके^३ भङ्गदा प्रोक्ता कार्यकाले सदोदिता ।
 अनेनैव प्रकारेण येन येन च कर्मसु ॥ १६ ॥
 कर्त्तव्या जाघवो विद्या ज्ञात्वा^४ बुद्धिविशारदेः ।
 अभङ्गं सीसके जातं शुद्ध उत्पत्त्यकारकम् ॥ १७ ॥
 हाटके श्वेतता जातेः^५ अक्षया^६ रजते यदि ।
 लघुद्रावः शुभे शुल्बे लोहे च द्राविणो कला ॥ १८ ॥

(1) Both A and B read एतत्, which is grammatically incorrect.

(2) संयोगे is the reading in A and B, which mars the metre.

(3) A and B reads सीसके.

(4) A reads ज्ञात्वा, which is incorrect.

(5) A and B read जाते, which is incorrect.

(6) A reads अक्षयो. B reads अक्षनी. Both the readings seem to be incorrect.

जासत्वे षडङ्गीना च काठिन्याभ्यधिकौ परौ ।
 कला एताद्य धातूनां जातिर्भवति शुद्धता^१ ॥ १८ ॥
 कला एतादृशी दिव्याः प्राप्तः^२ सिद्धस्तु जायते ।
 शुक्लजासत्वसंयोगे नारीधातुसु^३ जायते ॥ २० ॥
 कार्यानि ककरी प्रोक्ता पात्रामोदसु^४ कोमला ।
 मारणे जारणे दिव्या चारणे वोटने तथा ॥ २१ ॥
 निर्गन्धा वर्णरहिता जातिभेदकरी स्मृता^५ ।
 एतावद्गुणसंयुक्ता कार्यकारणसंयुता ॥ २२ ॥

(1) जाति भवति शुद्धताः, a variant in A. जाति भवति रशुद्धिवाः, an incorrect variant in B.

(2) A and B read प्राप्ते, which is grammatically incorrect.

(3) A reads नारीधन्यसु. B reads नारीधन्यस्तु. Both seem to be incorrect. (Vide verse 14.)

(4) B reads पात्रामोदसु, which is unintelligible.

(5) A reads मता.

(6) Both A and B read एतद्, which destroys the metre.

संस्कारेः संस्कृता सर्व्वेः^१ सर्व्वसिद्धिकरी स्मृता ।
 नानासुवर्णकार्य्येषु रूप्यकार्य्येषु संयुता ॥ २३ ॥
 धातुधौता च या^२ धातुः सुधामायःसुसंस्कृता ।
 कार्य्यसिद्धिकरी^३ श्रेष्ठा ज्येष्ठकार्य्यविधायिका^४ ॥ २४ ॥
 सर्व्वथाशु सुधामायः^५ आसग्रहणग्राहकः (१) ।
 ग्राहयेत् आसमात्रेण पाचयेदशनं^६ स्त्रियम् ॥ २५ ॥
 स्वकौयाशनसंपक्वे^७ जाते भवति सिद्धिदा ।
 अन्यथा नेव सिध्यन्ति जायते मृग-अम्बुवत् ॥ २६ ॥

(1) A and B want सर्व्वेः, thus rendering the foot incomplete.

(2) A and B read ये, which is not correct.

(3) कार्य्यसिद्धिकरी is the variant in A and B.

(4) A and B read विधायिका, which is grammatically incorrect.

(5) A has an incomplete foot सर्व्वतेषुधा. B also has सर्व्वो तेसुधा.

(6) A reads पाचयेत् अशनं. B reads पाचयेत् अशने. Both of them seem to be incorrect.

(7) B reads संयुक्ते.

तस्मात्तेनैव यत्नेन सुधामायः¹सुसंस्कृतिः ।

यथोक्तसंस्कृतियुता² सर्वतो धातुरुत्तमा³ ॥ २७ ॥

क्रियोचितसुसंस्कारान्⁴ कारयेद्यत्नतः सदा ।

यथोदितैस्तु संस्कारैर्युक्ता कार्य्यकरी सदा ॥ २८ ॥

सर्व्वलक्षणसंयुक्ता धातुधौता सदैव हि ।

जायते नैव सन्देहः कार्य्यकारणकारिका⁵ ॥ २९ ॥

पार्व्वत्युवाच ।

कियत्परिमिता धातुः संख्या वदतु मे विभो ।

उत्पत्तिर्लक्षणं तेषां स्थानं चैव⁶ पृथक् पृथक् ॥ ३० ॥

(1) A reads सुधासाय, B reads सुधामाय. Both are unintelligible.

(2) Both A and B read संयुक्ता, which mars the metre.

(3) सर्वे ते धातुरुत्तमाः, a variant in A and B, which is grammatically incorrect.

(4) A and B read only संस्कारा, which is incorrect.

(5) Both A and B read कारका, which seems to be incorrect.

(6) B reads स्थानं तेषां.

कथ्यतां देवदेवेश लक्ष्यलक्षणसंस्कृतिः ।

भेदोऽभेदोऽथ^१ योगश्च मारणं चारणं तथा ॥ ३१ ॥

पातनं द्रावणं चैव त्रोटनं जारणं तथा ।

सारणं जौवनं षष्ठं गोपनं लेपनं पुनः^२ ॥ ३२ ॥

जातिभेदः सुगन्धश्च मेलनं जरणं परम् ।

समग्रं कथ्यतां देव उपधातुकरी क्रिया ॥ ३३ ॥

महादेव उवाच ।

शृणु देवि प्रवक्ष्यामि धातुस्थानानि लक्षणम् ।

उपधातुरनेका हि^३ तेषां मारणचारणम् ॥ ३४ ॥

अक्षयं राग(?)^४कारं च शोधनं बन्धनं तथा ।

मारणादि च यत् प्रोक्तं तत् सर्वं श्रूयतां शुभे^५ ॥ ३५ ॥

(1) भेदाभेदाद्य is the incorrect reading in A and B.

(2) A reads युतः, which is senseless.

(3) उपधातुरनेकानि, an incorrect variant in A and B.

(4) Both A and B want this word, which may be supposed to be राग or बल here.

(5) तत् सर्वं कथयामि ते, a variant in A.

पार्वत्युवाच ।

प्रथमं वद देवेश धात्वनुक्रमलक्षणम् ।

प्रत्येकस्थानरूपं हि गुणसम्बन्धकारकम् ॥ ३६ ॥

महादेव उवाच ।

शृणु देवि प्रयत्नेन सिद्धान्तवचनं मम ।

येन विज्ञानमात्रेण जायते धातुक्तक्रिया ॥ ३७ ॥

प्रथमे धातुनामानि संचेपात् कार्यकारणम् ।

कथयामि च ते भद्रे पश्चात् स्थानस्य संपदः^१ ॥ ३८ ॥

आदौ सुवर्णनामानि संचेपात् शृणुतां प्रिये ।

स्वर्णं सुवर्णं सूर्य्यं च ह्यट्कं वह्निरोचनम् ॥ ३९ ॥

सु(स) रङ्गं च तथा लोहं देवधातुर्मनोहरम् ।

वेशी^२ विश्वासगं चैव धर्मदं क्षुधिदेवता ॥ ४० ॥

जीवनम् अमृतं चैव हेमं^३ हिमवतोद्भवम्^४ ।

देववक्त्रभगं दिव्यं संसारोत्तारणं महत् ॥ ४१ ॥

(1) Both A and B read संपदि, which has no sense.

(2) A reads वशी.

(3) हेम is generally used

(4) हिमवदुद्भवं is the correct term.

जीवनं सर्वलोकानां¹ नारीणां रञ्जनं शुभम् ।

अन्यानि विविधनामानि² गोप्यगोप्यतराणि च³ ॥ ४२ ॥

रजतं च तथा रूप्यं चन्द्रश्चन्द्रस्य दीपकम् ।

शुभ्र ज्योतिःकरं⁴ सूर्योपद्वीजं तारकं तथा ॥ ४३ ॥

अनन्ता वर्तते तेषां कथा वृद्धिकराश्च ये ।

स्थापितं लौकिकं चेव⁵ येनाग्रन्यसमूहनम् ॥ ४४ ॥

शीतवीर्यं लघुवीर्यं विषघ्नं वातनाशनम् ।

रसपुञ्जीकरं श्रौतं धातुपुञ्जनकारकम् ॥ ४५ ॥

(1) The first term in the previous verse is only जीवनं. But here it is सर्वलोकजीवनं. Hence there is no repetition.

(2) अन्यानि विविधान् नामान्, an incorrect variant in A and B.

(3) गोप्यगोप्यतराणि च is the reading in A and B, which has no clear sense.

(4) A and B read शुभ्रज्योतिकरं, which is incorrect.

(5) A reads लौकिका देवा, which leaves out चेव.

रतिदं बहुवीर्यं च शुभधाम च संचयम् ।
 एतानि रजतनामानि शतान्यन्यानि सन्ति वै^१ ॥४६॥
 ताम्रं च^२ त्वम्बकाधिष्ठं शुल्वं नागस्य मर्द्दनम् ।
 नीलं च नीलविभ्रमं वमनं^३ चैव पातकम् ॥ ४७ ॥
 उष्णम् उष्णकरं सिंहं कृकशं कालमर्द्दनम् ।
 हेमगर्भं^४ च कामोदं विषदं विषनाशनम् ॥ ४८ ॥
 आरक्तश्च सहायश्च^५ मन्मथो मार एव च ।
 एतानि शुल्वनामानि अन्यानि विविधानि च ॥४९॥
 जासत्वं च जरातीतं राजतं यशदायकम् ।
 रूप्यभ्राता वरीयश्च त्रोटकं कोमलं लघु ॥ ५० ॥

(1) A has शतान्यानि वर्त्तते. B has शतानानि वर्त्तते. Both the readings are grammatically incorrect.

(2) च is dropped in A and B.

(3) The sense of नीलविभ्रमं seems to be नीलविभ्रमं—नीलशोभम्. A reads वमनं, which is incorrect.

(4) A reads हेमगर्भे.

(5) A and B read सहायं च.

चर्मकं खर्परं चैव रसकं रसवर्द्धकम्^१ ।

सदापथ्यं बलोपेतं पीतरागं सुभक्षकम् ॥ ५१ ॥

एतत्तु^२ खर्परनाम कार्यकर्मसु सिद्धिदम्^३ ।

रसराराजार्द्रकं कर्म^४ कृतं सिद्धिषु^५ जायते ॥ ५२ ॥

वपुस्तापहरं वज्रं रजतारिखं^६ नीरदम् ।

शीतवीर्यकरं त्रीदं रतिदं तापहारकम् ॥ ५३ ॥

(1) रसवर्द्धक, the reading in A and B, is not grammatically correct.

(2) तत्ते is the reading in A and B; which is incorrect.

(3) Both A and B read कार्यकर्मसु सिद्धिदान्, which is grammatically incorrect.

(4) रसराराजार्द्रकान् कर्मोन्, an incorrect variant in A and B.

(5) A reads कृते सिद्धिषु. B reads कृते सिद्धिषु. Both are incorrect.

(6) Both A and B read रजतानि च, which is senseless here.

मेहघ्नं माहलादृ(?)भूतं सहायं धातुशेषयोः ।
 एतानि त्रपुनामानि सुसिद्धं कार्यकारकम्¹ ॥५४॥
 सीसकं² धातुभङ्गं च मृतकं रोचकं परम् ।
 रक्तं च रक्तवीर्यं च³ रक्तवस्तुविवर्धनम् ॥ ५५ ॥
 अन्तरूप्यं च गम्भीरं धातुभञ्जनकारकम् ।
 ग्राहकं रसराजेन अक्षोभ्याक्षोभणं परम् ॥ ५६ ॥
 विचित्रं विनतं चैव नानारङ्गप्रदायकम् ।
 नागं नगालयं प्रोक्तं सिद्धकं कण्ठशोधनम् ॥ ५७ ॥
 पण्डं पण्डकरं⁴ चैव दुरितं पण्डकारकम् ।
 एतानि⁵ नागनामानि कार्यकाले प्रयोजयेत् ॥५८॥
 लोहं च आयसं शूरं सूर्यकर्मविशारदम् ।
 हन्तकं खननं स्पर्णमारकं⁶ ताटकं मलम् ॥ ५९ ॥

(1) सुसिद्धे कार्यकारकान्, an incorrect variant in A and B.

(2) A and B read शीघ्रकं.

(3) B has only रक्तं वीर्यं च, which is incomplete.

(4) A reads खडं खडकरं चैव.

(5) A and B read एतत्ते, which is incorrect.

(6) A has स्पर्णे प्रारकं. B has स्पर्णे मारकं

अजरं च जरायुक्तं धात्वाद्यम् अवनीसुतम् ।
 कालेयं जीषणं कालं रुधिरं रोगनाशनम् ॥ ६० ॥
 ग्रन्थिदं सर्वधातूनाम् अक्षीभ्यं जलवज्जिघृ ।
 वज्जिदं वज्जिवीजं च सर्वधातुसहायकम् ॥ ६१ ॥
 एतानि लोहनामानि ज्ञात्वा कर्माणि कारयेत् ।
 जायते^१ सकला सिद्धिर्वियोगयोगसंयुता^२ ॥ ६२ ॥
 नामानि धातुसंयोगे जातानि तानि च शृणु^३ ।
 शुल्बस्वर्परसंयोगे जायते पित्तलं शुभम् ॥ ६३ ॥
 पित्तलं चैव नारीकं कफदं गन्धदुर्जयम् ।
 वर्णदं दुर्बलं चैव राजतं वज्रभं लघु ॥ ६४ ॥
 वज्रताम्रसंयोगेन जायते तेन^४ कांस्यकम् ।
 कांस्यकं कीमलं चैव नैरसं रसकाठिनम्^५ ॥ ६५ ॥

(1) A reads नीयते.

(2) वियोगायोग is the variant in A. वियोगायोग is the variant in B. Both the readings seem to be incorrect.

(3) जातानि च ते शृणु, an incomplete variant in A and B.

(4) A has जातेनैव. B has जायते तेनैव.

(5) A and B read erroneously कठिनं.

तीव्रनादं महाशब्दम्¹ उद्यकान्ति रविग्रहम् ।
 ज्वालापिधानं रौद्रं च ग्राहकं² धूम्ररोधनम् ॥ ६६ ॥
 एतानि³ कांस्थनामानि कार्यकाले प्रयोजयेत् ।
 बन्धने धारणे चैव मुद्रणे धूमबन्धने ॥ ६७ ॥
 खर्परैः सह पारदं दिव्यं⁴ किञ्चित् प्रमेलयेत् ।
 जायते रसको नाम नानारोगहरो भवेत् ॥ ६८ ॥
 नागस्तु रहते⁵ होनो मृतधातुस्तु जायते ।
 स एव कीमलाग्निस्थः⁶ सिन्दूरं जायते ध्रुवम् ॥ ६९ ॥

(1) A reads महाशब्दं. B reads महत्शब्दं. Both the readings are incorrect.

(2) A reads ग्राहकं, which has no clear sense.

(3) And B read एतन्ने, which is incorrect.

(4) पारदौ दिव्यौ is the reading in A and B, which is incorrect.

(5) B reads रहते, which is not correct.

(6) कीमलाग्निस्थे is the reading in A and B, which is not correct.

अनेकाः^१ साधयेद्विद्या मन्त्रयन्त्रकरीः क्रियाः ।
 पूजनार्थं मम गुणाः सर्व्वं कल्पितरोचनाः^२ ॥ ७० ॥
 ताम्रदाहजलैर्योगि जायते तुल्यकं शुभम् ।
 नाना रसायनी विद्या साधयेत् सा^३ सदैव हि ॥ ७१ ॥
 रसरसक(?)^४ योगेषु राजमर्यादा जायते ।
 राजकं जायते नाम नारी राजकलागतिः^५ ॥ ७२ ॥
 संयोगि साधनं दिव्यं वियोगि साधनं शुभम् ।
 वियोगं पुनर्योगं रसताम्रे शुभो विधिः^६ ॥ ७३ ॥

(1) A reads एनेका. B reads एतेका. Both are incorrect.

(2) A and B read कल्पितरोचनं.

(3) सा is not found in A and B.

(4) A and B read रसरसयोनेषु, which is incomplete.

(5) नाराराजकलागतिः, a variant in A. नाराजकलागतिः, a variant in B. Both the readings seem to be incorrect.

(6) A and B read शुभविधिः.

अनेका साधनी विद्या साधयेद्द्रव्यकाङ्क्षितम्¹ ।

लभते रसायनीं विद्यां स्वस्थोऽपि विस्तृतोद्यमौ ॥७४॥

अनेनैव प्रकारेण ज्ञायते नाम कर्मभिः ।

नामकर्मज्ञता² जाते चित्ते निर्मलता³ भवेत् ॥७५॥

एतत्ते कथिता धातोरुपधातोस्तु तां⁴ शृणु ।

येन विज्ञानमात्रेण कालकाल्या⁵ न लिप्यते ॥ ७६ ॥

उपधातोस्तु मध्येषु श्रेष्ठा माता रसायनी ।

तस्या नामानि वक्ष्यामि पश्चात् स्थानगुणानपि⁶ ॥७७॥

(1) A reads द्रव्यकोखितः. B reads द्रव्यकाङ्क्षितः.

(2) A and B read नामकर्मरदाजाते, which is unintelligible.

(3) A and B read निर्मला, which is not grammatically correct.

(4) A and B read ते, which is incorrect.

(5) A reads कालकाय. B reads कालकाय. Both the readings are incorrect.

(6) Both A and B read गुणानि च, which is incorrect.

हरितालं विसङ्गा च रङ्गदीप्तिकरी सदा ।
 तालं च हरिता हंसी श्वेतपीतविधायिनी ॥ ७८ ॥
 नर्त्तकस्य प्रिया देशी निशा चैव निशाचरी ।
 पारदस्य त्रयकरी पञ्चच्छेदकरी स्मृता^१ ॥ ७९ ॥
 रोगहा जीविनी जेत्री जरादारिद्र्याश्रिणी ।
 एतानि तालनामानि संक्षेपात् कथितानि ते^२ ॥ ८० ॥
 युक्तो ज्ञानेन यः^३ कर्त्ता अक्षोभ्यो^४ जायते सदा ।
 अनेनैव प्रकारेण कर्त्ता कर्माणि साधयेत् ॥ ८१ ॥
 मनःशिला शिला शृङ्गी कुनटी च क्षतोद्यमा ।
 दरदा^५ भगिनी देशी सिन्दूरस्य सखी सदा ॥ ८२ ॥

(1) The 78th and 79th slokas are not found in A.

(2) संक्षेपे विकथानिभि, a variant in A and B, which has no sense.

(3) युक्तज्ञानेन यः, an incorrect variant in A and B.

(4) A reads अक्षोभ्यो, which is incorrect.

(5) B reads दीरदा.

पुष्पा पुष्पवती¹ पत्नी शालिनी रसिनी गुणा ।
 एतत्तु च शिलानाम² कार्यकाले प्रयोजयेत् ॥ ८३ ॥
 अभ्रकं चैव व्योम³ च गगनं ग्राहकं परम् ।
 दुष्टवीर्यञ्च वातञ्च वज्रिनादोन्नताकृति⁴ ॥ ८४ ॥
 अजरम् अमरं घोरं घोरपण्डित्व⁵ नाशनम् ।
 रंसमूलरसातीतं रसज्ञे राज्यवर्धनम् ॥ ८५ ॥
 अमृतम् अमरं⁶ चैव महामृत्युविनाशनम् ।
 एतान्यभ्रकनामानि ज्ञात्वा कर्माणि कारयेत् ॥ ८६ ॥
 सोमलं मङ्गराजं च विषं वातविनाशनम् ।
 श्वेतवीर्यं बलग्रन्थि नीलउज्ज्वलकारकम् ॥ ८७ ॥
 स्वेदनं भेदनं चैव कामवीर्यविवर्धनम् ।
 बन्धनं सर्वधातूनां मारणं पारदे रसे ॥ ८८ ॥

(1) A reads पुष्पवती.

(2) एतत्तु च शिला नामान्, an incorrect variant in A and B.

(3) Generally used as व्योम.

(4) A reads वज्रिनादे एतः चतिः, which is incorrect.

(5) A and B read खड्गत्व, which is incorrect.

(6) A repetition of the name.

गगनग्राहके दिश्ये रसयुग्मे प्रमेलनम् ।
 एतानि मल्लनामानि कार्यकाले प्रयोजयेत् ॥ ८८ ॥
 हीनधातोश्च नामानि संक्षेपात् तानि च शृणु^१ ।
 येन विज्ञानमात्रेण जायते पारदो क्रिया ॥ ८९ ॥
 मुक्ता मुक्ताफलं वारि वारिजं स्वातिसम्भवम् ।
 शुक्तिगर्भं^२ च सगरं शृङ्गारं मङ्गलोदयम् ॥ ९० ॥
 तैजसम्^३ अमृतोद्भूतं शीतलं शिलीमं मनः^४ ।
 स्वयम्भवं कलं दौप्तं स्त्रियौ सौभाग्यदायकम्^५ ॥ ९१ ॥
 रतिराजग्रहः शोभाकामसन्दीपनं तथा ।
 मुक्तानामानि रम्याणि^६ ज्ञात्वा कर्माणि कारयेत् ॥ ९२ ॥

- (1) A reads वते ग्रह, which is incorrect.
- (2) B reads मुक्तिगर्भे, which is not correct.
- (3) B reads तैजसं, which is incorrect,
- (4) B reads मनः, which is not correct.
- (5) स्त्रियौ सौभाग्यदायिने, an incorrect variant in A and B.
- (6) A and B read ते रम्यान्, which is incorrect.

विद्रुमं वरदं¹ विलावल्लीजातं प्रवालकम् ।
 नौरसम्² अधरसीमा शिखरं शिखरोद्भवम् ॥ ८४ ॥
 वर्णदं विवरं चैव येवेयं³ च विभूषणम् ।
 विद्रुमस्येतन्नामानि⁴ कार्यकाले प्रयोजयेत् ॥ ८५ ॥
 चर्मकं कूर्मकं चैव कमठपृष्ठं सकालकम् ।
 कमठं कर्कशं चैव कलिङ्गजातमाशुभम् ॥ ८६ ॥
 कचकं कद्वहुः⁵ कर्म लोके कचकटं तथा ।
 एतानि कूर्मपृष्ठस्य नामानि च विशेषतः ॥ ८७ ॥
 शङ्खं च जलजं चैव देववादितमेव च ।
 विष्णुवल्गुभक्तं⁷ चैव सोमदैवतकं शुभम् ॥ ८८ ॥

(1) A reads विद्रुमे वरदं. B reads विद्रुमे वरदे.

(2) A reads नौरसे.

(3) A and B read दावेयं.

(4) A has विद्रुमेनावि. B has विद्रुमैनानि. Both are incorrect.

(5) कलिङ्गनाशुभं is an incomplete variant in A and B.

(6) A has कन्वककद्वहुः. B has कचकर्कशः.

(7) B reads erroneously विष्णुवल्गुभाभक्तं.

वरायुधं च वरदं शुभं माङ्गल्यदायकम् ।
 अजेयं सर्वजन्तूनां दानवास्त्रि वरोदयम्¹ ॥ ८८ ॥
 गम्भीरं घोषशब्दं च पवित्रं पारदं गृहम् ।
 एतानि² शंखनामानि वामदक्षिणकावभौ³ ॥ १०० ॥
 शुक्तिका सीफिका⁴ कान्तौ मुक्तामाता गरीयसी ।
 चन्द्रपत्नी पयोद्याही संपुटो पटवादिनी ॥ १०१ ॥
 रजताभासिनी दीप्ता वङ्गवारिविशोषणी ।
 पद्मकरीगतिः पद्मगर्भ⁵ समुद्रसम्भवा ॥ १०२ ॥
 उत्तमा मध्यमा नीचा त्रिविधा सागरोद्भवा ।
 नद्युद्भवा तु सा नीचा⁶ नीचकर्मविशारदा ॥ १०३ ॥

(1) Both A and B read वरं देयं, which destroys both grammar and metre.

(2) A and B read एतत्ते, which is grammatically incorrect.

(3) A reads वामदक्षिणकावभौ. B reads वामदक्षिणमावभौ.

(4) B has only सीफा.

(5) A and B read पद्मेगर्भं.

(6) नद्युद्भवा तन्नीचा, an incomplete variant in A.
 नद्युद्भवा तन्नीचा, an incorrect and incomplete variant in B.

एतत्तु लक्षणं शक्तेः¹ कर्मकाले प्रयोजयेत्² ।

ज्ञात्वा यः कुरुते कर्म सिद्धयेत् सकलं फलम् ॥ १०४ ॥

गजोद्भवं रदं³ दन्तं द्विजं चैव तु पुष्पकम् ।

नारीसौभाग्यदं चैव गजभूषणसम्मुखम् ॥ १०५ ॥

तेलरचाकरं श्रीदं संपुटं पुटिकं तथा ।

नामानि गजदन्तस्य अन्यानि मध्यमानि च⁴ ॥ १०६ ॥

पिच्छकं कुर्कटं च व शिखिपिच्छं सुचित्रकम् ।

हरिमौलिधरं श्रीदं मोहनं चन्द्रकं तथा ॥ १०७ ॥

नागारिं सर्पदमनं विषदं विषनाशनम् ।

एतानि शिखिपिच्छस्य नामानि विविधानि च

॥ १०८ ॥

(1) A and B read एतत्ते लक्षणा शक्ति, which is an incorrect variant.

(2) कर्मकार्ये प्रयोजने, a variant in A, which seems to be incorrect.

(3) A reads वरदं, which is incorrect.

(4) अन्यसे मध्यमानि च, a variant in A and B, which is grammatically incorrect.

नखं सङ्घटयपुरं^१ धातुकीमलकारणम्^२ ।

वज्रं^३ दुर्गन्धिकं चैव तुरीटापस्तु चोभकम्^४ ॥१०८॥

कचं केशं च बालं च भूर्जजालकमेव च ।

श्मामं चैव घनं प्रोक्तं कर्कशं नर्मदं लघु ॥ ११० ॥

एतानि धातुनामानि यथाकस्मिन्निधानकम् ।

ज्वात्वा आरभ्यते कर्म स्वस्थे सिद्धिः प्रजायते ॥१११॥

पार्वत्युवाच ।

शम्भो शङ्कर विश्वेश विश्वनाथ जगद्गुरो ।

श्रुतानि चैव नामानि स्थानानि कथ्यन्तां^५ प्रभो ॥११२॥

(1) न सङ्घटयपुरं, a variant^१ in A- न सङ्घटयपुरं, a variant in B. Both are incorrect.

(2) B reads कारकं.

(3) B reads वज्रं, which is not correct.

(4) A reads तुरीटापस्तुचोभकं.

(5) A and B read कथ्यन्तां, which is grammatically incorrect.

महादेव उवाच ।

शृणु देवि प्रयत्नेन स्थानानि विविधानि च ।

सुवर्णस्योदयो धातोः सर्व्वव्यापकपर्व्वते^१ ॥ ११३ ॥

पार्थिव्यं हि च तत् सर्व्वे^२ मृदामध्यात् प्रजायते ।

तस्मात् स्थानस्य संक्षेपः श्रूयतां सादरं^३ शुभे ॥ ११४ ॥

हिमं च प्रथमं कल्पं मेरुमध्ये सदैव हि ।

दुर्लभं मर्त्यलोकेषु कष्टेनैव तु लभ्यते ॥ ११५ ॥

पुनर्हेमाद्रिणा तेन जायते सर्व्वदा शुभे ।

महाशीतकृते^४ तेन दुर्लभं स्यात् सदैव हि^५ ॥ ११६ ॥

पञ्चाजम्बूनदीद्वृतं जम्बूद्वीपेषु जायते ।

तच्च कष्टतरं मन्ये दुर्लभं तत् सदैव हि ॥ ११७ ॥

(1) A reads वचोत. B reads पचात. Both the readings are incorrect.

(2) पार्थिव्यानि च ते सर्व्वे, an incorrect variant in A and B.

(3) A and B read सादरात् which is incorrect.

(4) A reads महत्शीतकृते, which is incorrect.

(5) B reads सदैव हि, which is incorrect.

पृथिव्यां धातुमध्येषु सर्व्वेषामधिकं सदा ।
 लोहाधिकतरं तत्र ज्ञातव्यं सर्व्वदा शुभे ॥ ११८ ॥
 कष्टे निःसारणं तेषां मौल्यादधिकं जायते ।
 तस्मात्तेनैव यत्नेन साधनं क्रियते नरैः^१ ॥ ११९ ॥
 असाध्यसाधनं तस्य जातं सर्व्वयुगे शुभे ।
 तस्मात्तु^२ बहुमूल्येन सर्व्वधातूपरिस्थितिः^३ ॥ १२० ॥
 पुनः स्थानं कृतं तेन लङ्कायां च सदैव हि ।
 उद्धृतं तेन यत्नेन मर्त्ताद्भीतं मया शुभे ॥ १२१ ॥
 पाव्वत्युवाच ।

महारुद्र शङ्कर श्रीमन्^४ लोकनाथ जगत्पते ।
 कथं ते मानुषे भीतिः^५ कथ्यतां परमेश्वर ॥ १२२ ॥

(1) A has कथ्यते नराः. B has जयते नराः. Both are incorrect.

(2) A and B read तस्मात्ते, which is incorrect.

(3) सर्व्वधातूपरिस्थितिः, an incorrect variant in A and B.

(4) A and B read erroneously सन्नाद.

(5) श्रीमान्, a reading in A and B, is not correct.

(6) मानुषादभीतिः is the correct form.

महादेव उवाच ।

सुवर्णस्थैषा महतौ^१ भीतिर्मानुषसम्भवा ।

उच्चो नीचपटं सम्यक् जायते बहुले रतिः ॥ १२३ ॥

मया मानुषभीतिन^२ उद्धितं सादरेण च ।

दुर्लभं च विशेषेण प्राक् कलियुगे इदम्^३ ॥ १२४ ॥

पाव्वंत्युवाच ।

मदीये मानसे नाथ जातोऽसौ संशयो महान् ।

भवतां मानुषी भीतिः कथं तु जगदीश्वर^४ ॥ १२५ ॥

महादेव उवाच ।

कारणं वर्त्तते देवि अव्याख्येयं सदेव हि ।

कथनीयं त्वयि भद्रे यतस्त्वं^५ मम वल्लभा ॥ १२६ ॥

(1) A and B read सुवर्णस्थैषा महतान्, which is not correct.

(2) मां च मानुषीभीतिन, an incorrect variant in A and B.

(3) A and B read इमे. This foot is incomplete.

(4) A reads कथं ते जगदीश्वर. B reads कथं ते जगदीश्वर.

Both are incorrect.

(5) यत्तेत्वं is an incorrect variant in A and B.

बुद्धिचतुरतावृद्धिर्जायते च कलौ युगे ।
 मानुषे च भवतीह^१ मम क्षोभानुवर्त्तिनी ॥ १२७ ॥
 तस्मात्तैर्वहुले^२ द्रव्ये साध्यते गन्धकी क्रिया ।
 अथवा पारदी चैव मम क्षोभानुवर्त्तिनी ॥ १२८ ॥

पार्वत्युवाच ।

श्रुता सा गन्धकी विद्या सर्वसौभाग्यदायिनी ।
 सङ्गभक्षकता सा च^३ न सिध्यति गरीयसी ॥ १२९ ॥
 भवता पूर्वमुक्तं हि सङ्गभक्षणयोगतः ।
 न सिध्यति च ते विद्या सदा गन्धकपारदी ॥ १३० ॥
 तस्मात्तु कथ्यतां देव मनो^४स्त्वानिविवर्जितम् ।
 सुवर्णसाधिनीं विद्यां^५ तस्माद्वदतु मे विभो ॥ १३१ ॥

-
- (1) A and B read भवतीह, which is not correct.
 - (2) A and B read तस्मात्ते, which is incorrect.
 - (3) A and B read ते च.
 - (4) A reads मत.
 - (5) A and B read सुवर्णसाधिनी विद्या.

महादेव उवाच ।

मानसं मदीयं देवि जातं सम्यक् सुनिर्मलम् ।
 तथापि मानुषे भोतिर्विद्या^१ गन्धकपारदौ ॥१३२॥
 सङ्गभक्षणजं कष्टम्^२ उभे मेलापनं महत् ।
 सुष्ठु मन्त्रकृते वज्रौ ज्वलते तत्क्षणात् ततः ॥१३३॥
 मन्त्रवत् साधयेद्विद्यां साधयेद्यत्नतः क्रमात् ।
 तस्मात्तेनैव महता गोप्या सिद्धिकरी क्रिया ॥१३४॥

पार्वत्युवाच ।

पुरा प्रोक्तं त्वया नाद्य पटले पञ्चदशके^३ ।
 कैलासात् परमं सौख्यं भजते मन्त्रविज्ञानः ॥१३५॥
 क्रिया गन्धकिनी^४ मध्ये अथवा पारदौ शुभे ।
 कैलासादधिकं सौख्यं भुञ्जते विधिवन्नराः^५ ॥१३६॥

(1) A and B read विधे, which is senseless.

(2) A and B have कष्टं, which is incorrect.

(3) पटले पञ्चाशिके, a variant in A and B, which is incomplete.

(4) A and B read गन्धकिना.

(5) A and B read नरः, which is incorrect.

महादेव उवाच ।

निर्मलं मानसं जातं तव वाक्यविमोहितम् ।

कथयामास ते भद्रे गुणलक्षणसंयुतम्¹ ॥ १३७ ॥

स्वर्णोत्पत्तिस्त्रलं² नित्यं सर्वत्रापि विधीयते ।

उत्पादनगतिस्तस्य स्थाने स्थाने पृथक् पृथक् ॥ १३८ ॥

अयतां वरदे देवि स्थानं चैव यथोदितम् ।

तस्य वातोत्पत्तिरगुर्धमने स्वर्णं³ जायते ॥ १३९ ॥

पावकाद्रेर्भुवावाहुः⁴ सप्तरत्नाकरे तथा ।

समुद्रस्य तटे दिव्ये स्थानं स्यात् स्वर्णकस्य च ॥ १४० ॥

स्वल्पं च सिन्धुदेशेन कामरूपैस्तथैव च ।

अन्यैस्तु विविधैः स्थानैः साम्प्रतोत्पत्तिर्जायते ॥ १४१ ॥

(1) A and B read संयुतः, which is not accurate.

(2) Both A and B read स्वर्णोत्पत्तिः स्त्रलं, which is not correct.

(3) A and B add च after स्वर्णे.

(4) A reads पावकाद्रस्य भुवावाहुः. B reads पावकाद्रस्य भुवावाहुः.

तच्च तत्रोत्पत्तिस्तेषां यत्र यत्र हिमद्रवः ।

प्रसरन्ति भुवि संघाः¹ संशयो नास्ति ते सदा ॥ १४२ ॥

ताम्ब्रोत्पत्तिश्च महता सुखेनैव प्रजायते ।

तेषां स्थानानि वक्ष्येऽहं² याथातथ्येन च शृणु³ ॥ १४३ ॥

नेपाले कामरूपे च⁴ वङ्गले मदनेश्वर⁵ ।

गङ्गाद्वारे मलाद्री च स्नेच्छदेशे तथैव च ॥ १४४ ॥

पावकाद्री जीर्णदुर्गं रूमदेशे फिरङ्गके ।

एतान्युदितस्थानानि⁶ सर्व्वपर्व्वतके⁷ सदा ॥ १४५ ॥

जासत्वं यत्तु⁸ दिव्यं हि स्थानानि तस्य च शृणु ।

कुम्भाद्रावथ⁹ काम्बोजे रूमदेशे वलक्षति ॥ १४६ ॥

(1) अग्नि is the variant in A. अग्नि is the variant in B.

(2) स्थानान् प्रवक्ष्येऽहं is the incorrect variant in A and B.

(3) A and B read ते शृणु.

(4) नेपालं कामरूपं च, a reading in A and B.

(5) वङ्गालं मदनेश्वरं, a variant in A and B.

(6) एतानि उदितस्थानानि, an incorrect variant in A.

(7) A and B read सर्व्वतने, which is incorrect.

(8) A and B read यत्ते.

(9) A and B read कुम्भादेश, which is incorrect.

एतान्युभयोः स्नानानि^१ रजःस्नानं च^२ उच्यते ।
 जासत्वं वङ्गले नागं नेपाले च सदैव हि ॥ १४७ ॥
 केदारं कर्मकाण्डे च व्रजस्य के त्रिपुरे तथा ।
 एतत्स्नानानि दिव्यानि^३ गोप्यान्यन्यानि
 तानि ह^४ ॥ १४८ ॥
 लोहाद्रौ^५ लोहकृतकर्म गयाद्रौ^६ गौतमाद्रिके^७ ।
 विन्ध्यमध्ये^८ हि सर्व्वत्र नलाद्रौ^९ निष्कलेऽपि वा
 ॥ १४९ ॥

(1) एति उभयोः स्नानान्, a reading in A. एति उभयोः स्नानान्, a reading in B.

(2) A and B read रजस्नानानि.

(3) A and B read स्नानकान् दिव्यान्.

(4) चन्वा गोप्या तितेति ह, a variant in A and B, which is senseless.

(5) A and B read लोहाद्रे, which is incorrect.

(6) Do. Do. गयाद्रे, Do.

(7) Do. Do. गौतमाद्रिके, Do.

(8) Do. Do. विन्ध्यमध्ये, Do.

(9) Do. Do. नलाद्रे, Do.

वाम्बके विमले^१ चैव लौहाकशालिवाहने ।

समुद्रस्य तटे रम्ये आद्ये अन्ते च मध्यगे ॥ १५० ॥

लोहस्यैतानि स्थानानि^२ हाटकैश्च^३ सदैव हि ।

किञ्चित्^४ गोप्यानि दिव्यानि संस्कारैः रक्षितानि च^५

॥ १५१ ॥

युक्ते तु संस्कृते तेषु स्वर्णी सिद्धिः प्रजायते ।

अयुक्ते नैव लभ्या तु^६ युक्ते प्राप्तिः सदैव हि ॥ १५२ ॥

पारदे गन्धके धात्वोः योग औषधकृत्^७ सदा ।

मानसे निर्मले चैव लभ्यते^८ हाटकी क्रिया ॥ १५३ ॥

(1) A reads विमले.

(2) लोहस्यैतानि च स्थानानि, a variant in A and B, which is incorrect.

(3) A reads हाटके च.

(4) किञ्चित् is the reading in A and B, which is incorrect.

(5) A reads ले. B reads ते.

(6) A and B read लभ्यते, which is not correct.

(7) Do. Do. योग्यौषधकृत्, Do.

(8) Do. Do. लभ्यते, Do.

अन्यथा नैव लभ्या तु¹ विना मन्त्रेण सिध्यति ।
 तस्मादेवं² प्रयत्नेन निर्मलं मानसं शुभम् ॥ १५४ ॥
 अशुभं समलं चैव मानसं सर्व्वदा भवेत् ।
 तस्मात्तु चतुराहारि³ सर्व्वदा शुभमानसः ॥ १५५ ॥
 जायते च क्रिया सिद्धा हाटकी भवति सर्व्वदा ।
 मन्त्रसिद्धिः प्रजायेत सर्व्वकर्माणि साधयेत् ॥ १५६ ॥
 अनेनैव प्रकारेण उत्तमा हाटकी क्रिया ।
 सर्व्वकार्य्यकरी नृणां चतुर्वर्गफलप्रदा ॥ १५७ ॥

महादेव उवाच ।

प्रोक्तसंपुटके चैव स्थूलकाचीयकेन च ।
 उष्णाङ्गारकते अग्नी⁴ सुमुरं छागरेकजम् ॥ ८ ॥

- (1) A and B read लभ्यते, which is not correct.
- (2) A and B read तस्मादेवं, which is not correct.
- (3) A reads चतुरादारे, which is unintelligible.
- (4) A reads जतेरधि. B reads चतेरधि.

खर्पराख्ये पुटे चैव चारण्योत्पलकेन च ।
 साहं विनास्ति(?)गति च ज्वलिते अर्द्धमर्द्धगे¹ ॥ १० ॥
 एवानुक्रमतो योगे पुटमेकं च जायते ।
 चतुरंशेन जामत्वं सुवर्णाद्वापयेत् सुधीः ॥ ११ ॥
 प्रति संपुटपुटे चैव उद्धयेत् कुण्डखर्परे ।
 स्वाङ्गशीतं² समुद्धृत्य लेपमुत्तारयेत्ततः³ ॥ १२ ॥
 पुनर्लेपः प्रदातव्यः⁴ पुनः चारान् प्रदापयेत् ।
 पुनरेव घोटनं देयं सादरं पुनरेव हि ॥ १३ ॥
 अनेनैव प्रकारेण तुर्थांशसंपुटेन हि ।
 सुवर्णसंयुतं तच्च⁵ गालयेत् चारसंयुतम् ॥ १४ ॥
 ज्वलिते तोलयत्येव तिलाहं संपुटं प्रति ।
 नस्त्रीभूतं च रक्षेयं संस्कारैः शुध्य साम्प्रतम् ॥ १५ ॥

(1) A and B read ज्वलितेरर्द्धमर्द्धगा.

(2) स्वाङ्गशीतेन is the reading in A and B, which is not accurate.

(3) A and B read लेपमुत्तारये ततः, which is incorrect.

(4) A and B read पुनर्लेपं प्रदातव्यं, which is not correct.

(5) A and B read ते च, which is incorrect.

एतत्क्रमक्रमेणैव सुवर्णं मनुसंचय ।
 तद्गुणे शोणिमापीते महत्ततः प्रजायते ॥ १६ ॥
 आरक्तं पीतसंयुक्तं जायते हाटकं महत् ।
 हाटकं मत्तकं^१ चैव न च ह्येनेन योजयेत् ॥ १७ ॥
 कलागुणगते वृद्धिर्जायते उत्तमे नरे^२ ।
 अनेनैव प्रकारेण मात्राद्विगुणं दापयेत् ॥ १८ ॥
 कलावय^३मिते वृद्धिर्दापिता वृद्धिरिष्यते ।
 निर्द्दीपं जायते दिशं द्रव्यसंपत्तिदायकम् ॥ १९ ॥

पार्ष्वत्युवाच ।

अधिकेन कृते तव^४ शोणपाने सुशोभने ।
 जायते कोटिशं देव संयोगे अधिके सति ॥ २० ॥

- (1) A and B read सुवर्णान्, which is not correct.
- (2) A and B read हाटके मत्तके चैव.
- (3) उत्तमो नरः, a variant in A and B.
- (4) A and B have कलावयं.
- (5) A and B have ते च, which is incorrect.

महादेव उवाच ।

शोणपाने च संयोगे भङ्गदः अस्ति¹ निश्चयः ।

द्विगुण² शोणपानेन कलंकं जायतेऽशुभम्³ ॥ २१ ॥

वेधसंगं सुधनार्थं त्रिंशंशे दिक्पलोपमम् ।

अतिरिक्तकृतं तच्च जायते सगुणं महत् ॥ २२ ॥

गालयेद्यत्रपूर्वेण छायेद्रससमांशके ।

समांशे गन्धकं देयं शुद्धं पीतक⁴ रागकम् ॥ २३ ॥

चयतुर्ध्वांशकं तालं दापयेद्रसमोदितम् ।

तद्वर्द्धं सादरं देयं मर्ह्येत् कन्यकारसे ॥ २४ ॥

यामत्रितयमामर्ह्य⁵ छायाशुष्कमण्डजे रसे ।

अतिशुस्वेतरे खले अथवा लोहसंभवे ॥ २५ ॥

(1) A and B read भङ्गदा अस्ति, which is incorrect.

(2) Do. द्विगुणे.

(3) Do. शुभं, which appears to be incorrect.

(4) Do. पीतक, which is senseless

(5) यामत्रितयमामथ, an incomplete variant in A and

मर्दयेद्यन्नपूर्वेण छायाशोषितं कारयेत् ।
 काचकूप्ये प्रदातव्यं^१ वह्निर्बालुकयन्त्रगः^२ ॥ २६ ॥
 नखसंख्यामिति यामि पाचयेद्रसं शोभने ।
 स्वाङ्गशीते तु संजाते पुनः खले निधापयेत् ॥ २७ ॥
 रसेनानेन आमर्दय छायाशोषितं कारयेत् ।
 उक्तयामि रसे^३ दत्ते पुनः शोषं^४ प्रदापयेत् ॥ २८ ॥
 उक्तान्नौ दापयत्येव पुनः संस्कारमाचरेत् ।
 संस्कारे त्रिविधे जाते अग्निपूर्वे क्रमोदिते ॥ २९ ॥
 जायते रसराजोऽसौ सर्वसामर्थ्यदायकः ।
 संचयेत्तण्डुलार्धस्तु अतिविक्रमवेगवान् ॥ ३० ॥
 जायते प्रबला बुद्धिः त्रिदिने सेवते यदि^५ ।
 सार्धंषड्विक्रमेनैव दिने मासफलं सदा ॥ ३१ ॥

(1) प्रदातव्या, a reading in A and B.

(2) यन्त्रगा, a reading in A and B.

(3) रसी is the variant in A and B.

(4) शोष्णे is the incorrect reading in A and B.

(5) A and B read सेवनेनपि, which is grammatically incorrect.

जायते नात्र सन्देहः सिद्धिर्गन्धकसम्भवा ।
अनेनैव प्रकारेण रसासिद्धिः प्रजायते ॥ ३२ ॥

* * * * *

पार्वत्युवाच ।

श्वेतता कर्मणा केन^१ जायते रजतेषु च ।
क्रमेण राजतौ सिद्धिः पद्याद्वाटकसम्भवा ॥ ३८ ॥

महादेव उवाच ।

अद्यानन्तरता विद्या धातुसंस्कारकारिणी ।
जामत्वे^२ कठिने जाते शुद्धे कोमलकारिणी ॥ ३९ ॥
तथाच पीतशुल्केषु जायते शुद्धनम्बता ।
मृणु यत्ने क्रिया दिव्याः शुद्धजामत्वसम्भवाः ॥ ४० ॥
पिष्टं हयखुरोत्थं च द्विगुणं धातुतः सदा ।
अर्द्धन्तु दापयेत् स्त्रावे अर्द्धं निम्ने च^३ रक्षयेत् ॥ ४१ ॥

(1) केन कर्मण, an incorrect variant in A and B.

(2) जामत्व^३ is the reading in A and B, which is not correct.

(3) A and B read निम्नेन.

निर्मलं धातुजं द्रावं स्रावचूर्णेन टालयेत् ।
 यदर्धं च स्थितं निम्नं तत्कालं दापयेत् सुधीः ॥ ४२ ॥
 उपरि संपुटं देयं समुद्रकुक्कुटे पुटे^१ ।
 स्वाङ्गशीतं समुद्धृत्य जायते निर्मलं महत् ॥ ४३ ॥
 जासत्वे सोमलं देयम् उक्तभागेन^२ साम्प्रतम् ।
 चूर्णान्तरगतं कृत्वा उज्ज्वलं जायते महत् ॥ ४४ ॥
 तदेव^३ जासत्वं चैव दिव्यम् उज्ज्वलगं सदा ।
 रूप्यार्धं मेलयत्येव जायते शुद्धता शुभा ॥ ४५ ॥
 अनेनैव प्रकारेण धनं किञ्चिच्च जायते ।
 धने चैव तु संजाते कारयेद्दूर्ध्वाः क्रियाः ॥ ४६ ॥

* * * * *

अतीव शोभना विद्या रसगन्धकजा सदा ।
 अतिसौभाग्यदा सा^४ च साधके सुखदायिका ॥ ४७ ॥

(1) समुद्रं कुक्कुटे पुटे, a variant in A and B, which seems to be incorrect.

(2) उक्तभागेन, a variant in A and B.

(3) A and B read स एव, which is not correct.

(4) Do. ते Do.

एतादृशं च जासत्वं शोधितं गन्धकेन च ।
 धालधौतेन ताम्रेण पुञ्जितं^१ सुभगं सदा ॥ ६८ ॥
 पुञ्जितं जायते दिव्यं शुल्बपीतं शुभोदितम् ।
 निर्मलं जायते तच्च हीनहाटकसन्निभम् ॥ ६९ ॥
 लघुता जायते तस्य किञ्चिन्नाय्या गुरुता सदा ।
 जायते गुरुता दिव्या पुञ्जिते हाटकेन च ॥ ७० ॥

२८ श-पटलादुद्धृताः श्लोकाः ।

पार्वत्युवाच ।

पूर्वमुक्तं त्वया नाथ धने सिद्धिस्तु जायते ।
 लघुद्रवकृते धातौ^२ वद^३ किं तत्र मुञ्चते ॥ ४३ ॥

महादेव उवाच ।

क्रिया अग्नेः शुभा तेषां द्रव्यसिद्धिविधायिनी ।
 शृणु यत्नेन तां भद्रे क्रियां रंगीति नागजाम् ॥ ४४ ॥

(1) A and B read पु'जिते.

(2) A and B read धाते, which is incorrect.

(3) A reads वच. B reads वचः.

आनयेत् पारदं दिव्यम् अधजङ्घ्विपातितम् ।
 चालयेद्यत्नपूर्वेण खल्ले पिष्टं तु कारयेत् ॥ ४५ ॥
 तैलेनानेन आमर्द्ध्य भावनां क्षणमात्रतः ।
 निम्ने डमरुके यन्त्रे अग्निं दद्याद्विचक्षणः ॥ ४६ ॥
 उत्थयेद्यामयुग्मेन स्वाङ्गशीतं समुद्धरेत् ।
 पुनः समाननागेन पूर्व्ववत् चालयेत् सुधीः ॥ ४७ ॥
 पुनरेव हठादग्नौ उक्तयामेन सिद्धयति ।
 रसे द्विवारके चैव ह्रीनहेमोत्तमोत्तमः^१ ॥ ४८ ॥
 तौलिके रक्तिकायुग्मं दापिते वर्णपञ्चकम्^२ ।
 अनेनैव प्रकारेण जायन्ते षोडश कलाः ॥ ४९ ॥
 द्रव्यवृद्धिकरं तच्च जायते नात्र संशयः ।
 पुनरेव क्रिया रम्या पारदे नागचारिणी ॥ ५० ॥
 द्विगुणे चारिते तत्र^३ जायते चन्द्रिका शुभा ।
 आभासेन शिखिग्रीवा जायते नात्र संशयः ॥ ५१ ॥

(1) ह्रीनहेमोत्तमः, an incomplete variant in A.

(2) पञ्चकः is the reading in A and B, which is incorrect.

(3) तत्र is the incorrect reading in A and B.

पुच्छिते हीनहेमेन जायते क्रयविक्रयः ।

अनेनैव प्रकारेण जायते धनसंपदः ॥ ५२ ॥

अत ऊर्ध्वं क्रिया या च^१ विद्या नागस्य संभवा ।

रसे तु नागजे चैव विधिनानेन वर्तते ॥ ५३ ॥

तायते^२ सकला विद्या नागतैलस्य संभवा ।

सर्व्वा सा^३ शोभना विद्या तौवदारिद्र्यनाशिनी ॥ ५४ ॥

अथातः संप्रवक्ष्यामि त्रपूणां विधिमुत्तमम्^४ ।

येन विज्ञानमात्रेण जायते रजतं महत् ॥ ५५ ॥

अनेका राजती सिद्धिः जायते परमोत्तमा ।

जायते धनसिद्धिश्च^५ जायते नात्र संशयः ॥ ५६ ॥

(1) A and B read ये च, which is incorrect.

(2) A and B have ताते, which is incomplete.

(3) A and B have ता, which is not correct.

(4) A and B have विधिरुत्तमा, which is grammatically incorrect.

(5) A and B have स्यात् instead of च, which is a tautology.

पार्वत्युवाच ।

वद वैभवदातारं^१ वङ्गं विज्ञानदायकम्^२ ।

ज्ञात्वा सिद्धिमवाप्नोति गुणैः सौख्यकं च यम् ॥५७॥

महादेव उवाच ।

आनयेच्छोभनं वङ्गं विख्यातसमुद्रवम् ।

गालयेद्यत्नपूर्वेण ढालेत् कृष्णण्डजे रसे ॥ ५८ ॥

त्रिःसप्तककृते तच्च^३ जायते निर्मलं शुभम् ।

तदुत्थान् कारयेत् पचान्^४ शुचिविज्ञान् यथोदितान्

॥ ५९ ॥

रक्षयेद्यत्नपूर्वेण आनयेद्वर्किकं^५ पयः ।

भावयेत् शुक्तिकाचूर्णम् उज्ज्वलं वङ्गिशोधितम् ॥६०॥

(1) दाता च, a variant in A and B.

(2) दायकः, a variant in A and B.

(3) ते च is the incorrect variant in A and B.

(4) A and B read तदोत्थान्, which is incorrect. The word पत्र is used here in the masculine gender.

(5) B reads वट्टिकं.

मर्दयेदयन्नपूर्वेण यावत्तेपः सुलक्ष्यते¹ ।
 यवाद्यं लेपयत्येव पत्रान् तु यन्नपूर्वकम् ॥ ६१ ॥
 छायाशुष्के च संजाते दापयेच्छुक्तिसंपुटे ।
 चूडाधो लेपयत्येव सन्धो यन्नेन मुद्रयेत् ॥ ६२ ॥
 मेलितौ माषगोधूमौ पिष्टलेपं प्रदापयेत् ।
 छायाशुष्के च संजाते मृन्मयं लेपं दापयेत् ॥ ६३ ॥
 सुशुष्के च² गजे पाच्यं स्वाङ्गशीतं³ समुद्धरेत् ।
 जायते उज्ज्वलं वज्रं वातशुष्कं तु कारयेत् ॥ ६४ ॥
 यः कश्चित् मूर्च्छितश्चैव⁴ जीवयेज्जीवनक्रियाम् ।
 स हि वज्राग्रयेणैव⁵ उज्ज्वलः कठिनो⁶ भवेत् ॥ ६५ ॥

(1) यावत्तेपस्य लक्ष्यते, a variant, which seems to be incorrect.

(2) सुशुष्केन, a variant in A and B.

(3) स्वाङ्गशीते, a variant in A and B.

(4) ये केचित् मूर्च्छिते ते च, an incorrect variant in A and B.

(5) सदैवंगालयत्येव, a variant in A and B, which is unintelligible.

(6) A and B read उज्ज्वलं कठिनं, which is incorrect.

अतिशुद्धतरं तच्च जायते नात्र संशयः ।

सर्व्वकर्मकरं श्रेष्ठं नानाभागेन पुञ्चितम् ॥ ६६ ॥

भोगभागसमायुक्तं वङ्गं च गुणसंयुतम् ।

लक्षणार्थे^१ धनार्थे च^२ संयोगे साधयेत् सदा ॥ ६७ ॥

जायते सुभगं तच्च संसारे शोभनं भवेत् ।

अनेनैव प्रकारेण जायन्ते धनसम्पदः^३ ॥ ६८ ॥

पार्व्वत्युवाच ।

अपी शुद्धतरं जाते का क्रिया वद मे विभो ।

लक्षणार्थं धनसंपत्तेः क्रिया या च पृथक् पृथक् ॥ ६९ ॥

महादेव उवाच ।

लक्षणेन^४ च नारीणां भिक्षा भिक्षेन वर्त्तते ।

अनेका धनदा विद्या जायते सुभगा महत् ॥ ७० ॥

अतीव शोभना सा च गुणसामर्थ्यदायिका ।

येन विज्ञानमात्रेण साधके धनमुत्तमम् ॥ ७१ ॥

(1) B reads भक्षार्थे.

(2) धनार्थे is omitted in B.

(3) जायते धनसंपदा, a variant in A and B.

(4) A and B read भक्षणेन.

जायते नैव सन्देहो धनसामर्थ्यकं महत् ।
 अतिसौभाग्यसम्पत्तिर्जायते नात्र संशयः ॥ ७२ ॥
 आनयेत् शुद्धं तं वङ्गं गालयेत् टङ्गैः सह ।
 पिण्याकसुरसे दिव्ये ढालयेद्यत्नपूर्व्वकम् ॥ ७३ ॥
 सप्तढालकृते शुद्धे कठिनं रजतोपमम् ।
 जायते नैव सन्देहः पुञ्जिते रजते शुभे ॥ ७४ ॥
 रजतं जायते शुद्धं संभारं कारयेत् सुधीः ।
 अन्येष्वेव विधिर्दिव्यो दिव्यरजतसंभवः^१ ॥ ७५ ॥
 आनयेत् शोधितं वङ्गं तद्वर्द्धं पारदे कृलेत् ।
 निधाय^२ शोभने खले तुर्यांशे दापयेत्ततः ॥ ७६ ॥
 मर्दयेत् कन्यकावीर्यं यामं षोडश यत्नतः ।
 हंसपद्मा रसे दिव्ये तत्समं मर्दयेत् सुधीः ॥ ७७ ॥
 समानाण्डरसेनैव मर्दयेद्यत्नपूर्व्वकम्^३ ।
 क्वायाशुष्के च^४ संजाते शोषान्ते^५ बालुके पचेत् ॥ ७८ ॥

(1) दिव्यादिव्यं रजतसंभवा, a variant in A and B.

(2) A and B read निधाय or निधाय.

(3) यत्नपूर्व्वकः, a variant in A and B.

(4) क्वायाशुष्केन, a variant in A and B.

(5) A reads शोषान्ति. B reads सीशति.

अग्नेनैव प्रकारेण क्रमादग्निं प्रदापयेत् ।
 प्रह्वराष्टकेऽष्टकेनैव त्रिवारं हठं दापयेत् ॥ ७६ ॥
 जायते च रसं दिव्यं भक्षणे च सुधासमम् ।
 नारौणां दापयेद्यत्ने संयोगे नागकेसरैः^१ ॥ ८० ॥
 तदर्द्धाः सुष्ठु^२ गोधूमाः सहैवं तोलकार्द्धम् ।
 अतिसौख्यकरं तच्च^३ रक्तिमात्रार्द्धं वर्द्धते ॥ ८१ ॥
 पुंसि अजगुणोपेते यथा च गंधकी गतिः ।
 नरार्थं भक्षणे यातो जातित्रयसमन्वितः ॥ ८२ ॥
 अग्नेनैव प्रकारेण क्रमेण वर्द्धयेद्रसम् ।
 जायते रसजा सिद्धिः नात्र कार्या विचारणा ॥ ८३ ॥
 सुकृत् सुधाकरं वर्द्धं गालयेद्यत्नपूर्वकम् ।
 तज्जलं शोषयत्येव शतांशे रसदापिते ॥ ८४ ॥
 रजतं जायते शुद्धं कलाद्वात्रिंशतः स्फुटम् ।
 अन्यं वै मेलयत्येव विक्रये शुभदं महत् ॥ ८५ ॥

(1) A reads नागकेसरै.

(2) B reads त्रिषु.

(3) A and B read ते च, which is incorrect.

अनेनैव प्रकारेण जायते धनसंपदः ।
 साधयेत् सिद्धिदा विद्या देहसामर्थ्यदायिनी ॥ ८६ ॥
 मेलयेद्भोगभागेन मर्हनाहरदो विधिः ।
 पीते भावनया अग्नौ^१ सार्द्धवृद्धेन सिद्धयेत् ॥ ८७ ॥
 शुद्धताम्रे प्रदातव्यं शतशिं हाटकोत्तमम् ।
 जायते नात्र सन्देहो यथा जाम्बूनदीप्पवम् ॥ ८८ ॥

• • • • •
 पार्वत्युवाच ।

ताम्रं च तुल्यजं दिव्यं जायते केन विक्रियाम् ।
 वद विश्वेश्वर शम्भो सिद्धिं ताम्रविधानकीम् ॥ ८९ ॥
 महादेव उवाच ।

शृणु शुद्धक्रियां दिव्यां तुल्यताम्रस्य सम्भवाम् ।
 येन विज्ञानमात्रेण साधयेद्रसकुम्भिकाम् ॥ ९० ॥
 साधयेत् पञ्चानृतं दिव्यं महासौख्यप्रदायकम् ।
 ज्ञात्वा कालेन लीयेत संसारसुखभाजने ॥ ९१ ॥

(1) A and B read रघौ, which is incorrect.

(2) सिद्धा ताम्रविधानक', an incorrect variant in A and B.

आनयेत्तत्त्यक्तं दिव्यं पीतगन्धकसम्भवम् ।

दापयेच्छोभने खले अर्कचौरिण भावयेत् ॥ ६७ ॥

मर्हयेदयन्नपूर्वेण याममात्रमखण्डितम्^१ ।

तेनैव धातुयोगिन सुवर्णं^२ सुलभतां व्रजेत् ॥ ६८ ॥

एतादृशी परा धातुर्वर्तते धातुर्मध्यमा ।

सुलभा शुभदा प्रोक्ता मम सान्निध्यगा सदा ॥ ६९ ॥

पार्वत्युवाच ।

ये गुणा नागजे ताम्रे वद विश्वस्य वज्रभ ।

प्रयोजनवस्तु शक्यं चतुरिणेव चोदितम् ॥ ७५ ॥

महादेव उवाच ।

अनेका गुणा^३ नागेषु पूर्वमुक्ता हि^४ पारदे ।

किञ्चित् शेषतरा ये च शृणु देवि प्रयत्नतः ॥ ८६ ॥

(1) A reads याममात्र मखण्डितः. B reads याममात्रे मखण्डितः.

(2) A and B read सुवर्णः.

(3) अनेकान् गुणान्, a variant in A and B.

(4) मुक्तानि पारदे, an incorrect variant in A and B.

नागस्य सम्भवं ताम्रं मध्ये मेलापनं कृतम् ।
 विभागे तु कृते तत्र^१ जायते कुम्भिका शुभा ॥ ८७ ॥
 तन्मध्ये गालयेन्नागं त्रिवारं यत्नपूर्वकम् ।
 जायते निर्मलं स्वर्णम् उदितं चैव कुम्भिके ॥ ८८ ॥
 विभागे साम्प्रतं दत्त्वा अमृतं जायते शुभम् ।
 उक्तकार्यकराद्यैते नान्यथा वचनं मम ॥ ८९ ॥
 तस्मात् साधयते दिव्यं भूनागोद्भवजं शुभम् ।
 अनेका साधयेद्विद्या रससामर्थ्यदायिका ॥ ९० ॥

Colophon in A

इति श्रीरुद्रयामले उमामहेश्वरसंवादे सुवर्णकल्पे
 सुवर्णप्रशंसा नामाध्यायः ।

Colophon in B

इति श्रीरुद्रयामले उमामहेश्वरसंवादे धातुमंजरीं
 सुवर्णप्रशंसा समाप्ता ।

(1) A and B read ते च, which is incorrect.

Extracts from
SUARNATANTRA
OR
SVARNATANTRA.

सुवर्णतन्त्रात् वा स्वर्णतन्त्रात्
उद्धृताः श्लोकाः ।

A = MS. from Benares. *

B = MS. from Ramnákáli's matha, Dacca. †

श्रीगणेशाय नमः ।

श्रीराम उवाच ।

देवदेव महादेव ऋद्धिबुद्धिफलप्रद ।

पूर्वं संसृचिता ऋद्धो रसायनपरा परा ॥ १ ॥

यस्याः साधनमात्रेण स्त्राराट्पुत्रो नरो भवेत् ।

तां सिद्धिं वद मे देव यदि त्वं भक्तवत्सलः ॥ २ ॥

* The name of this MS. is सुवर्णतन्त्रम्.

† The name of this MS. is स्वर्णतन्त्रम्.

पूर्वं तु कथितं देव रत्नतन्त्रं त्वया मम ।
 गुटिकाः कथिताः पूर्वं सहस्रद्वितयं शिव ॥ ३ ॥
 पारदाः कथिताः पूर्वं षट्शतं मृतिरूपकाः ।
 धातूनामष्ट कल्पास्तु पूर्वमेव प्रकाशिताः ॥ ४ ॥
 धातुयोगाख्यकल्पस्तु पूर्वमेव प्रकाशितः ।
 रत्नानां करणे तन्त्रं पूर्वमेव प्रकाशितम् ॥ ५ ॥
 किन्तु स्वर्णाख्यतन्त्रं तु न मञ्चं कथितं प्रभो ।
 कश्यपेन महेशानाभ्यर्दितोऽस्मि महेश्वर ॥ ६ ॥
 भूमिदानं मया दत्तम् ऋषये कश्यपाय वै ।
 कश्यपेन मयि प्रोक्तं भूमिभागं त्यज प्रभो ॥ ७ ॥
 स्थानाथं तु महेशान रक्ताब्धिः प्रार्थितो मया ।
 वाणमात्रं स्थलं तेन दत्तं मम महेश्वर ॥ ८ ॥
 स्थानं प्राप्तं महेशान भक्षणं मम नास्ति वै ।
 भक्षणं देहि मे देव यदि पुत्रोऽस्मि शङ्कर ॥ ९ ॥

ईश्वर उवाच ।

शृणु राम प्रवक्ष्यामि रहस्यातिरहस्यकम् ।
 स्वर्णतन्त्राभिधानं तन्त्रं कल्परूपेण कथ्यते ॥ १० ॥

तत्राद्यं स्वर्णतन्त्रस्य कल्पं शृणु सुपुत्रक ।

तैलकन्दाभिधः कन्दः सिद्धकन्दः प्रकीर्तितः ॥ ११ ॥

कन्दः कमलवत्तस्य पत्राणि कञ्चवच्छिणो ।

तथैव तु महत्पत्रं तैलं स्रवति सर्व्वदा ॥ १२ ॥

जलमध्ये सदा पुत्र त्वार्द्रं एव प्रतिष्ठते ।

विषकन्देति विख्यातो विषाच्च कायनाशनः ॥ १३ ॥

तैलस्रावी महाकन्दः परितस्तैलवज्जलम् ।

दशहस्तमिति देशे सरते तैलवज्जनम् ॥ १४ ॥

महाविषधरः पुत्र तदधो वसति ध्रुवम् ।

कन्दाधः कन्दच्छायायां नान्यत्र गच्छति प्रिय ॥ १५ ॥

तत्परीक्षाविधानार्थं कन्दे सूचीं प्रवेशयेत् ।

सूचीद्रावः क्षणात् पुत्र तत्कन्दन्तु समाहरेत् ॥ १६ ॥

तत्कन्दं तु समादाय शुद्धसूतं खलेक्षिधा ।

मूषायां निक्षिपेत् तन्तु तत्तैलं तत्र निक्षिपेत् ॥ १७ ॥

दीप्ताग्निं तु महाराम वंशाङ्गरेण दापयेत् ।

तत्क्षणाभृतिमायाति लक्षवेधो भवेत् सुत ॥ १८ ॥

ततः प्रभक्षयेद्रामक्षुब्धिद्राहारको ध्रुवम् ।

तालं शुद्धं समानौय तत्तैलेन खलेत् सुत ॥ १९ ॥

सप्तधा प्रत्यहं राम त्वेवं विंशद्दिनं ध्रुवम् ।
 हरितालो मृतिमेति निर्धूमो जायते ध्रुवम् ॥ २० ॥
 अग्नी पुत्र ततो दद्यान्निर्धूमो जायते सुत ।
 तत्तालं चाष्टधातौ तु दद्याद्द्रावे कृते सति ॥ २१ ॥
 सर्ववेधी भवेदेव शतविद्धो भवेत् सुत ।
 तत्तैलं तु समादाय ताम्रद्रावे विनिक्षिपेत् ॥ २२ ॥
 तत्क्षणात्ताम्रवेधः स्यात् दिव्यं भवति काञ्चनम् ।
 वङ्गे कांस्ये यदा दद्यात्तदा रौप्यं भवेत् सुत ॥ २३ ॥
 ताम्रे लौहे तथा रौप्यां तारे खर्परसूतके ।
 तत्क्षणात् वेधमायाति दिव्यं भवति काञ्चनम् ॥ २४ ॥

* * * * *

शंखद्रावस्य भेदान् द्वि तत्कल्पान् शृणु साम्प्रतम् ।
 लौहद्रावस्तथा ताम्रद्रावश्चैव द्वितीयकः ॥ १ ॥
 शंखद्रावस्तृतीयः स्यात् ह्यन्तालश्च(?) चतुर्थकः ।
 दन्तद्रावः पञ्चमः स्यात् अन्नवेधी तु मध्यमः ॥ २ ॥

* The above 24 Slokas are not found in MS. A.

पञ्चानां तु परीक्षा ये कथ्यते शृणु साम्प्रतम् ।
 लौहसूचीं समादाय लौहद्रावे विनिक्षिपेत् ॥ २ ॥
 तत्क्षणाद्भवतां याति सा सूची नात्र संशयः^१ ॥
 ताम्रद्रावे तथा सूचीं सन्धिभेदीं विनिक्षिपेत् ॥ ४ ॥
 सूचीद्रावो याममात्राद्भवत्येव न संशयः ।
 शंखद्रावे शंखसूची चतुर्यामिन संद्रवेत् ॥ ५ ॥
 हन्तालोऽधो^२ यदा गच्छेत् दन्ताद्यान्ना भवन्ति हि ।
 दन्तद्रावोऽप्यधो गच्छेद्दन्तद्रावो भविष्यति ॥ ६ ॥
 एवं परीक्षां कृत्वादी प्रयोगानारमेद्ब्रुवम् ।
 वज्रसूषां ततः कृत्वा शुद्धसूतं विनिक्षिपेत् ॥ ७ ॥
 लौहसूचौद्रावरसं तत्र यत्नेन निक्षिपेत् ।
 तत्राग्निं दापयेद्यद्वात् पुनस्तत्र^३ रसं क्षिपेत् ॥ ८ ॥

(1) The above 7 hemistichs are not found in A.

(2) A reads दन्ताद्याधो. B reads दन्ताद्याधो. Both the readings seem to be incorrect; since B has हन्तालोऽधो चतुर्धा in the 2nd Sloka.

(3) B reads पुनस्तत्र, which is not correct.

स सूतो मृततामिति¹ नात्र कार्या विचारणा ।
 अष्टधातुषु तं सूतं दत्त्वा काञ्चनतां व्रजेत् ॥ ८ ॥
 तं सूतं भक्षयेद्यो हि सोऽमरत्वमवाप्नुयात्² ।
 तस्य मूत्रपुरीषेषु शुक्लं³ भवति काञ्चनम् ॥ १० ॥
 ताम्रद्रावप्रयोगं वै शृणु यत्नेन साम्प्रतम् ।
 तद्रसं तु समादाय शुद्धताम्रे विनिक्षिपेत्⁴ ॥ ११ ॥
 तत्ताम्रं स्वर्णतां याति भैरवस्य प्रसादतः ॥ १२ ॥

Colophon in A—इति त्र्योसुवर्णतंत्रे हरपार्वतीसंवादे
 दुस्पर्शाकल्पः द्वितीयः ।

Colophon in B—इति स्वर्णतन्त्रे लोहद्रावादिपञ्च-
 फलकल्पो द्वितीयः ।

(1) B has सा सूची मृतिमाप्नोति.

(2) A reads स मच्छेदमरत्वतां, which is incorrect.

(3) B reads तुल्य.

(4) शुद्धताम्रेषु निक्षिपेत्, a variant in B.

INDEX OF PROPER NAMES.

A

A'dhamalla lxix, lxxi, lxxxix.
 A'kbar, Emperor, lxxix.
 Albertus Magnus 45.
 Albérúni xxv.
 Amarasimha li.
 Amoghavagra xxxvi.
 A'nandánubhava xcvi.
 A'ndhrabhṛityas xxiii.
 Aniruddha 116.
 Archemedes 33.
 A'ryabhatta l, xci, xcii.
 Asaṃga xxvi, xlv.
 Asoka, king, proclamation of,
 ix.
 Asvaghosha xv, xxxiv,
 xxxviii.
 Atisa xxxvii.
 Aufrecht lxxiv, xciv.
 Augustine 45.

B

Balabhadra xcvi.
 Barth xlviii.
 Bauer 37, 39.
 Beal xxx, xlii.
 Bendall xxix.

Berthelot lxiv, lxxxi, lxxxvi,
 42.

Bhándárkar Dr., v, xxi.
 Bhāskara-A'ohārya 162.
 Bhāskara, (Siddha), xcvi 60.
 Bhattotpala 39.
 Bhavabhūti l.
 Bhāvamisra lxxix.
 Bhavyadattadeva xcvi.
 Bhojadeva xcvi.
 Boyle, Robert, 40, 53.
 Brahma Gupta l.
 Brahmajyoti lv, xc.
 Buddhāmitra xlvi.
 Bakka, king, ix.
 Bunyiu Nanjio, Catalogue of,
 xv, xxxiv, xxvi, xxxvi.
 Burnell lxviii.
 Burnouf xxvii, xxxii, xxxiii, li.

C

Chakradatta 149.
 Chakrapāni lxii, lxv, lxxix,
 xcvi, 42, 147.
 Chandrasena xcvi.
 Charaka lxxvi, lxxix, 21, 60,
 120, 126, 130, 131, 140,
 146, 150.

Charpata xvi.

Charpati, Siddha, lxii.

Colebrooke xci. xcii.

Cowell xxxiv, xxxviii.

Csoma (or Csoma Korosi or
Csoma de Korosi) xi, xxvi,
xxxviii.

D

Dalvana 127.

Dāmodara lix, lxx.

Dandī iv.

Dās, Saratchandra (S. C.)
xix, xxii, xxxvii.

David, Rhys, Professor, v,
xxvii, xxxiii, 43.

De-Chyo, king, xix.

Democritus xxiv.

Deva xv.

Devadatta lxxiv.

Dhanapati xvi, (Sūri) 58.

Dharmakīrti xlv, xlvi.

Dharmadharmātha lxiii.

Dignāga xxvii.

Diophantus xcii.

Dridhabala 149.

E

Edkin xxxiv.

Emerson 47.

Empedocles 49.

England 46.

F

Fah-hian, travels of, xxix,
xxx, xlii.

Finot, M., 41.

Fleet xxi.

Flückiger lxxvii.

G

Gahanānandanātha xcv.

Garbe 30, 35.

Garudadatta Siddha xvi.

Geber xxiv, lxiv.

Gopālakrishna lxxi, 56.

Gorakshanātha xvi.

Goudapa'da 58, 116, 119.

Govinda lviii, lxv, 21.

Govindabha'gavat lii, lix.

Govinda, Bhikahu, 12, age of,
57.

Govinda'cha'rya lxvii.

Govindana'tha Muni 58.

Gupta Abhaya'nanda, lxxiii.

H

Hammira, Ra'ja', lxx.

Hanbury lxxvii.

Harihara xvi.

Ha'rīta lxxix.

Hemachandra xxiii.

Heraclitus 49.

Hien, Tsang xv, xx, xxi.

Hipparchus xci.

Horiuzi xxxv.

Huvishka xi.

J

Jayadeva xxix.
Jayanta 60, 191, 193, 219.
Julien xv.

K

Ka'iana'tha lxiii.
Ka'lida'sa l.
Kana'da 49
Kanishka xi, xij, xxi, xxxiv.
Kaṣka'li xevi.
Ka'nashin xxxv.
Kapa'li xevi.
Kavibha'rati, Ra'machandra,
xxix.
Kaye xcii.
Kern xxv, xxxij, xxxiv, xlvii.
lxxxvii.
Kesavadeva xevi.
Kopp 45.
Kuma'ralabdha xv.
Kuma'rila 60.
Kushana, dynasty of. xi.

L

Lakshmi'svara, Siddha, lxv,
xcv.
Lassen xxi, xciii.
Lavoisier 51.
Lecky 45.

M

Madanaratha 12.
Ma'dhava lxviii, xlix, lii,
lxxviii.
Ma'dhavakara lxxiii.
Maha'ra'shtra xxiii.
Malla'ri xevi.
Ma'ndavya xl, lii, xciv, 8.
Mantha'nabhairava lvii. xcv.
Mathanasimha lxi.
Mathura' xxix.
Mathura'na'tha 202.
Max Müller xxxi, xxxii,
xxxiii, xxxv.
Medicii, the, xlvii.

N

Na'ga'rjuna, age of, i, xv;
bodhisattva xv; the boy
xvii, xviii; high priest of
Na'lendra xix, 49; matur-
ed the Ma'dhyamika philo-
sophy xix, 46; adept in
magic, alchemy, &c. xx.
lix, lxv; friendly epistle of,
xxii; contemporary of
Sa'tava'hana or Sa'liva'hana
xxiii, xli; author of books
xxiv; a comprehensive
name of Maha'ya'nism xxv;
dream of, xl, 5; debt of
obligation to, iii, lv, lvii

lxii ; dialogue between, 6 ;
 identical with Siddha, 131.
 Na'landa' xlii, Na'lenda' xlix,
 Na'lendra xvii, xix ; cala-
 mity of, xvii ; Oxford of
 Indian Buddhism xxvii.
 Nandi or Nandin lv, lvii, xcv,
 16.
 Narahari xcvi.
 Naya Pa'la, king, xxxvii.
 Nityana'tha, Siddha, lxi, lxxv.

O

Olympiodorus lxxxvi.

P

Padma-Sambhava xxvii.
 Paracelsus 46, 48.
 Parama'rtha xxvi.
 Pa'taliputra xxix, xlii.
 Patañjali xxvi, xcvi, 46, 49.
 Plato xxiv, 49.
 Pliny 36.
 Plotinus 47.
 Pra'nana'tha Siddha, xvi.
 Prasastapa'da, Bha'shya of,
 60 ; view of, 196, 215.
 Proclus lxxxvi.
 Ptolemy xci.
 Purochana lxxxiv.
 Pythagoras 44.

R

Raghuna'tha 60, 187, 218.
 Ra'machandra lxiii.
 Ra'ma'nuja l.
 Ra'mara'ja xcvi.
 Ra'masena lxxiii.
 Ratnaghosha xi, lii, xciv, 6.
 Ratnarakshita xli.
 Ra'vana lxxxi.
 Ray, Yogesa chandra, Prof.,
 39.
 Ripley, George, lxvi.
 Rodwell lxvi.

S

Sachau, Prof., xxv.
 Sadva'hana (= Bdye-Spyod)
 xxii.
 Sa'ka'nda 8.
 Sa'kyamuni i.
 Sa'kyasri xli.
 Sa'lina'tha lxxxi.
 Sa'liva'hana or Sa'tava'hana
 xxiii, xxiv, xl, 6.
 Sambhu lv.
 Samkara I, (A'cha'rya), 57, 58,
 60, 175, 177.
 Saṅgama-Srijñāna xli.
 Saṅkaramisra 211.
 Sānti Rakshita xxxvii.
 Sārāgadharma, date of, lxx, xc.

Sa'stri, Haraprasa'da (H. P.),
xliii.

Schiefner xx, xxi.

Sewell xlix.

Siva'ditya, Sapta-pada'rthi of,
186.

Smith, V., xxi.

Somadeva liv, lvii, xcv, 16.

Spencer 35, 37, 39.

Sridhara 60, 188, 193, 198.

Srīna'tha xevi.

Srī Saraha Bhadra xvii, xix.

Stein, Dr., xi.

Sukadeva 58.

Susruta lxii, lxxix, lxxxviii,
21, 42, 127, 128, 130, 131,
140, 141, 147, 148.

Svachchhanda bhairava lvii,
lviii. xcv, 21.

T

Takakasu xxvi.

Ta'ra' li.

Ta'ra'na'tha xv, xx, xlv.

Tatha'gata 12.

Tavernier, rule of, 40.

Temple, Sir William, 46.

Thibaut xci.

Thomas, St., 45.

Trimallabhatta xevi.

Trivikramabhatta lxv.

U

Udandapura xlii, xli, xlii.

Udayana or Udayana'cha'rya
viii, 60, 117, 205, 205, 206,
209, 210, 211.

Udyan, King, xxii.

Uddyotakara, Va'rtika of, 60 ;
refutation by, 158, 192,
194, 205, 208, 210.

Uma'sa'ti', (Tattva'rtha'dhi-
gama of,) 183.

V

Va'chaspati 60, 117, 119, 122,
123, 205, 209, 210, 212, 217.

Va'gbhata li, (psuedo) li, lxii,
lxxix, 42, 147.

Vaidyara'ja xevi.

Vandimisra xevi.

Vara'ha or Vara'hamihira

lxxxiv, lxxxvi, xci, 30, 33,
39, 40, Vrihat Samhita'
of, 60, 174, Vajra-lepa
(cements strong as the
thunderbolt) by, 133 ; size
of an atom, 166.

Varavara 60

Vardhama'na 202.

Vasubandhu xxvi, xxvii.

Va'sudeva xi, lix, xevi.

Va'tsya'yana xxii, 30.

Vidya'bhūshana, Satīsa-
chandra, (S. C.) xxvii.
Vijayanagara xlix.
Vijā'nabhikshu 60, 81, 95,
113, 119, 122.
Vikramasīla xlii, xlii, xlix.
Vrinda lxxix.
Vya'di lix, xcv.
Vya'sa or Vedavya'sa xxiv.

W

Waddell xxxv, xxxviii.
Waite 44, 47.
Weber xlvii, lxxxv.

Wema Kadiphses xi.
Wenzel xxii.
Whitney x.
Wilson xxxv.
Woepcke xciii.

Y

Yajña-Srī-Sa'takarwi xxiii.
Yasodhara lvi, lvii, xciv.
Yoga'cha'rya xxxvii.

Z

Zeller 44.

INDEX OF SUBJECTS

A

Acids, mineral, ...	...	lxxvii, 24
Adri ...	...	ii
Æthiop's mineral ...	...	6
Ahan'ka'ra, Ra'jasic, ...	...	70
Ta'masic, ...	...	70
Air, weight of, ...	...	223
A'ka'sa, aspect of, ...	...	88
the original ...	...	88
the derivative ...	...	89
A'ka'sa-atom ...	...	102, 104
Alechemy, Indian, origin of, ...	...	lxxxiii
Alechemical Tantras, Buddhist ...	...	i
Alkali, caustic, method of preparing, ...	...	42
Alum ...	...	10
Analysis and Synthesis, chemical—Elements and compounds ...	...	114
Añjana ...	...	11
Antimony ...	...	54
Asus (<i>vide</i> Parama'sus)		
Aphiyu'n ...	...	lxix
Ap-substances, simple and compound, ...	...	128
Aqua Regia ...	...	29
Arkapraka'sa ...	...	lxxxi
Arrak, essence, Persian, ...	...	lxxxii
Ashfa'mgahridaya ...	...	li
Atharva-vedas ...	...	lxxv
Atomic theory of the Buddhists ...	...	177
of the Jainas ...	...	178

Atomic combination, theory of, ...	186
Atomic characters, change of, (Pilupā'ka or Pitṭharapa'ka) ...	191
Atoms, (Parama'sus), genesis of, according to	
Viśṇu Para'sa, ...	99
according to Para'sara, ...	97-98
according to certain school of Veda'ntists, ...	99
linking of, ...	190
arrangement of, in space, ...	211
physical arrangement of, ...	212

B

Bauddha-sarvasva ...	xxvi
Bauddha-Sataka ...	xxix
Bauddha system ...	61
Bha'vapraka'sa ...	lxxviii, lxxix
Bhu'ta'di, units of, ...	111-113
Bhu'ta-Parama'sus, genesis and structure of, ...	91-96
order of genesis of, according to Patañjali, ...	102
Bhu'tas, genesis of, according to Vijñāna-bhikṣu,	101
cosmo-genesis of, ...	103-104
examples of different, ...	106-108
physical characters of, ...	125
mechanical mixture of the maha'-, ...	126
Borax ...	11
Brass ...	11
Buddha-charita ...	xxxiv, xxxviii

C

Calamine ...	2, 17, 22
Calomel ...	16, 24
Cat's eye ...	34
Causal series ...	82

Causation, doctrine of,	72
Sāṅkhya view of,	72
Pātañjala-Sāṅkhya view of,	73
chain of,	76
Chandrikā	lxxi
Chapala	314
Charmaka	24
Charpaṭa-siddhānta	xcvi
Chārvāka system	61
Chemical action and heat	205
Chemical analysis and synthesis—Elements and compounds	114
Chemical combination	192
Chemical compounds, preparation of,	131
Chemical compositions and decompositions	136
Chemical theory of Nyāya-Vaiśeṣika	185
Chemistry in the medical schools of ancient India	124
Chemistry in Dhātukriyā or Dhātumañjarī (Rudrayāmala Tantra)	24
in Dhāturaṭṇamālā	23
in Kākachandresvara-mata Tantra	12
in Rasachintā'mani of Madanāntadeva	18
in Rasahridaya of Bhikṣu Govinda	9
in Rasakalpā (Rudrayāmala Tantra)	19
in Rasanakṣhatramālikā of Mathana siṃha, physician to the king of Malwa	22
in Rasapradīpa	23
in Rasaprakāśa-sudhākara of Yasodhara	16
in Rasarājalakṣmi of Viśvadeva	22
in Rasaratna'kara of Na'ga'rjuna	I
in Rasaratna'kara of Nityana'tha	123
in Rasendrachru'da'mani of Soma'deva	14

in Suvarnatatra or Svarnatatra	...	...	28
Chemistry of colours	...	...	151-154
Chemistry of digestion	...	...	142-150
Chinese Buddhism	...	...	xxxiv
Chobchini	...	...	lxxvii
Chūlika'	...	...	11
(-lavana)	...	...	21
Cinnabar	...	...	20
factitious (Makaradhvaja)	...	...	23, 25, 27
Colour-potential, unit of,	...	—	93
Copper, extraction of,	...	...	4, 11, 20, 25
Copper pyrites, essence of,	...	...	22
Corundum	...	...	34
Cosmo-genesis, a bird's eye view of,	...	...	104-105
Cupel	...	...	11

D

Darada, essence of,	...	...	4, 11
Devi'sa'stra	...	...	lvii
Dharasis (invocations)	...	...	xxx, xxxi
Dha'tukriya'	...	...	lxxx
Dha'turatnama'la'	...	...	lxxiv
Diamond	...	...	34
hardness of,	...	...	35
faces of,	...	...	39
phosphorescence of,	...	...	40
Dichroism	...	...	37
Divyarasendrasa'ra	...	...	xevi
Dulva (by Csoma)	...	...	xx

E

Electrum	...	...	lxxxvi
Energy, transformation of,	...	...	70-71

potential form of,	72
liberation of,	74
modes of,	77
dissipation, of,	83
Evolution, beginning of,	64
formula of,	65
order of cosmic,	67
ditto according to the Vya'aa-bha'shya ...	69, 83
of matter (Ta'nma'trika srishfi)... ..	84

F

Fusion mixture	13
-----------------------	----

G

Gairika	11
Gandhakakalpa (a Tantra)	lxxxii
Garbha-yantram	6
Garuda	33
Garuda-pura'sa, the,	xcv, 31, 32
Gems, dissolution of,	5
fusion of,	13
knowledge of,	30
fusibility (liquefaction) of,	38
Gi'tagovinda	xxix
Glass	34
Gold	11, 20
augmented,	27
unaffected by fire,	52
Goraksha-sambhita'	xevi
Gunas (Reals)	61
acts of,	62, 70, 71
want of ubiquity of,	113

H

Harita'la (orpiment) ...	25
Hetero-Bhautic 'quasi-compounds' ...	199
Hinaya'na School ...	xxxiii
Hi'naya'nists ...	xiii, xxix
Hindus (ancient), mechanical, physical and chemical theories of, ...	59
Hira'kasa ...	21
Hi'raka'si'sa ...	21

I

Iatro-chemical period ...	lxi
Iron, killed, ...	14, 20

J

Jaina system ...	61
Jalpakaipataru ...	155
Jasada (or zine) (<i>vide</i> yasada) ...	lxxiv
Ja'sta ...	24

K

Kabbalists, the, ...	44
Kajjali ...	6
Ka'kachandi'vara ...	lix
Kakshaputa Tantram ...	6
Ka'masu'tra ...	xxii, 30
Ka'msy (bell-metal) ...	lxxxix
Ka'msyaka ...	25
Kakushtha ...	II
Ka'nta ...	II
Karpûrarasa ...	16
Karsha (= $\frac{1}{2}$ pala) ...	52

Ka'sisa (proper )	...	...	...	21
(pushpa )	...	...	...	21
Ka'sisas (vitriols )	...	...	...	21
Kharpara	...	...	...	lxxiv, 24
Khechara (mica )	...	...	...	11
Kira'tas	...	...	...	...lxviii, lxxxiv
king of,	...	...	...	12
Koshfai' apparatus, the,	...	...	...	lv, 8, 16
Kubjika'mata	...	...	...	xlii

L

Laghva'ryabhatti'yam	...	...	...	xcii
Lalitavistara	...	...	...	xxxii
Lead	...	...	...	11, 20, 25

M

Ma'dhyamika, a system of Philosophy,...	...	...	...	ii, xv, xxxvii
Maha'bha'rata	...	...	...	lxxxiv
Maha'bhūtas	...	...	...	170
constitution of,	...	...	...	171
Maha'rasas, the,	...	...	...	20
Mahat, the intelligible essence of Cosmos	...	...	...	67, 69, 70
Maha'vagga	...	...	...	xxxiii
Maha'ya'na School	...	...	...	xxxiii
Maha'ya'nism, origin and development of &c.,	...	...	...	ii, xii, xxviii
Maha'ya'nists	...	...	...	xiii, xxix
Makaradhvaja, preparation of,	...	...	...	55
analysis of,	...	...	...	57 (note)
Ma'kshika	...	...	...	11
Matter, general properties of,	...	...	...	179
Mdo (by Csoma )	...	...	...	xxxvii
Measures of weight and capacity	...	...	...	163-168
Medical authorities, succession of,	...	...	...	130

Mercury, fixation of,	5
killed,	19, 20
tests for,	23
Metals, (base), transmutation of,	2
(noble),	11
their loss in weight after calcination,	51
identification of—by their colouration of flames,	57
Mica	11
liquefaction of,	13, 20, 25
Milks—Bi-Bhautic quasi-compounds	202
Minerals, crystalline character of,	39
Mlechchha	lxxxiii
Mono-Bhautic compounds	192-198
Mono-Bhautic Earth-substance	127

N

Neo-Platonists, doctrines of the,	xxxvi, 44
Neo-Pythagoreans, the,	44
Nidānasamgraha	lxxxviii
Ni'lañjana	54
Nya'ya-Vaisheshika, views of,	109
chemical theory of,	185

O

Oils—Bi-Bhautic quasi-compounds	202
Opium	lxviii, lxxxii
Organic compounds	138
Orpiment	20, 25

P

Pa'la dynasty	xlvi
Pañchasiddhāntikā'	xc

Pañchkarana (quintuplication)...	...	...	170, 176
Paramāśus; cosmo-genesis of,	...	...	103-104
definition of,	...	...	118
magnitude of,	...	...	167
mixture of,	...	...	119
Parchment, Leyden,	...	...	lxxxi
Pa'rima'ndalya	...	...	167
Parina'ma—Evolutionary Process	...	...	173
Parina'ma-Va'da versus A'rambha-Vāda	...	...	155-158
Parispanda—Resolution of all physical action into			
motion	...	...	216
Phiraṅgaroga	...	lxxvii, lxxix, lxxxi, 24	
Phiraṅgas	...	...	lxxx
Pittala	...	...	25
Portuguese	...	...	lxxvi
Potentials, order of genesis of, according to			
Patañjali,	...	...	100-101
Prajñāpāramitā	...	xxxii, xl, li, 5	
Prakṛiti	...	...	60, 69, 70
Precious stones	...	...	35
Process for the fabrication of gold—Hemakriya'	...	...	18
Paulīśasiddha'nta	...	...	xcī
Pudgalas (Matter), specific characters of,	...	...	179
Puruṣa	...	...	64
Pyrrhonism	...	...	xv

Q

Qualities, of compounds	...	...	129
sensible,	...	...	180
change of—under the influence of heat (Pa'ka-			
jotpatti)	...	...	190
Quaternion	...	...	172

R

Rājanighaṁṣu...	...	...	...	35
Rajas, (Energy),	...	...	...	61
action of,...	...	...	...	62
activity due to,	...	...	...	63
Rājataranginī	...	...	...	xi, xxi
Rājāvarta	...	...	...	20
Rasachandrodaya	...	...	...	xvi
Rasadarpana	...	...	...	xvi
Rasadīpa	...	...	...	xvi
Rasadīpikā	...	...	...	xvi
Rasahridaya	...	xliv, lii, lviii, lxxviii, lxxxiv,	58	
Rasaka	...	...	11, 17, 20, 24	
Rasakaṇḍa	...	...	...	lviii
Rasakaṇḍikā	...	...	...	xvi
Rasakarpūra	...	...	...	lxiv
Rasakashāya Vaidyaka	...	...	...	xvi
Rasakaumudī	...	...	...	lxxviii
Rasakutuka	...	...	...	xvi
Rasamaṅgala or Rasamaṅgala	...	...	...	lxii, lxxiv
Rasamañjarī	...	...	...	lxxi, lxxxii
Rasāmṛita	...	...	...	lxxiv
Rasanakshatramālika	...	...	...	lxi
Rasapradīpa	...	...	...	lxxvii, lxxviii
Rasaprakāśa-sudhā'kara	...	...	...	lvi, xciv
Rasara'jalakshmi	...	...	...	lix
Rasara'jamahodadhi	...	...	...	xvi
Rasara'jamā'ṛiga'ṅka	...	...	...	xvi
Rasarañjana	...	...	...	lxxxii
Rasaratna	...	...	...	xvi
Rasaratna'kara	xxiii, xxxviii, xli, xlv, li, lxi, lxxxii,	xciv		
Rasaratnapradīpa	...	...	...	xvi
Rasaratnasamuchchaya	...	lii, liv, lxxiv, lxxxviii,	xciv	

division of mineral kingdom in, ...	135
date of, according to T. G. Kāla, ...	221
Rasaratnāvali' ...	xvii
Rasārṇava xlv, lii, liii, lix, lxii, lxv, lxxiv, lxxx, lxxxii, 57	
notice of different colours of metallic flames in, ...	135
Rasas, the, ...	11, 20
Rasasāra ...	xlix, lxv
Rasasarvesvara ...	xvii
Rasavisvadarpana ...	xvii
Rasayogamuktāvali' ...	xvii
Rasendrabhāskara ...	xvii
Rasendrachintāmaṇi ...	lxxii, xcv, 55
Rasendrachūdāmaṇi ...	liv, lxii, 52, 54
Rasendrakalpadruma ...	lxxiii
Rasendramaṅgala ...	9
Rasendrasārasaṅgraha ...	lxxi
Rasavaradarśana ...	xlvi
Rasavara-siddhānta ...	xvii
Ratnākara ...	lxxiv
Ratnapari'kshā ...	30, 31
Ratnatraya ...	iii
Realgar ...	20, 25
Reals, collocation of, ...	65, 70, 71
Rock crystal ...	34
Romaka ...	11
Romakasiddhānta ...	xc
Rosicrucians, the, ...	44, 47
Ruby, test of, ...	34
Rudrayāmala Tantra ...	lxxx, 27
"Rules of squares" ...	40
Rupabhratā ...	24

S

Saddharmapundarika	...	...	xxxii
Saindhava	...	...	11
Sal-ammoniac	...	...	11, 21
Saṁkhadra'vaka or Saṁkhadra'vaka	...	lxxvii, lxxxi,	29
Sa'mudra	...	...	11
Saṁkhadra'varasa	...	...	24
Sa'ṅkhyā-Pa'taṅjala system	...	...	59, 60
conceived view of,	...	...	109, 120, 121
view of the earlier,	...	...	124
Sapphire	...	...	34, 37
Sarjika'ksha'ra	...	...	11
Sa'rōgadharma-saṁgraha	...	lxix, lxx, lxxxviii	
Sasyaka	...	...	11, 20
Sattva, (the essence ),	...	...	61
defined,	...	...	62
conscious manifestation due to,	...	...	63
Saura'shtri'	...	...	17
(alums )	...	...	21
Sauvarehala	...	...	11
Sauviraṅjana	...	...	54
Siddhantas	...	...	xc
Silver	...	...	4, 11, 20
killing of,	...	...	23
Size of atoms (see Paramāṇus, magnitude of,)			
Smell-potential	...	...	95
Sound-potential, unit of,	...	...	92
Soups	...	...	202
Space, as extension and position,	...	...	81
Sthūlabhūta	...	...	69, 70
Subtilleka	...	...	xxii
Surkani'ti	...	...	40
Sūkshma-bhūtas	...	...	172

Sukhāvati, Vyūha	...	...	...	xxx
Sulphur	...	...	...	11, 20
Suramgama-Sūtra	...	...	...	xxx
Su'ryasiddha'nta	...	...	...	xc
Svarnasindu'ra, preparation of,	...	...	...	55
analysis of,	...	...	...	57 (note)
Syntaxis	...	...	...	xc
Syphilis	...	...	...	lxxvii

T

Tamas, (mass )	...	...	...	61
action of,	...	...	...	62
Stability due to,	...	...	...	63
Tanma'tra (Su'kshma'bhūta ).	...	...	...	67, 69
(infra-atomic particle of subtile matter ), ...	...	...	...	78, 86
genesis and structure of, according to Vishwupura'na	...	...	...	91-96
according to Para'sara	...	...	...	96
according to certain School of Veda'ntists,...	...	...	...	100, 120
Tāntric period, the,	...	...	...	1
Tantrists	...	...	...	44
Taste-potential	...	...	...	94
Tathāgata-gubyaka	...	...	...	xxx
Tīkshna	...	...	...	11
Timæus	...	...	...	lxxxvi
Time, infinite,	...	...	...	78
measures of,	...	...	...	158-163
Tin	...	...	...	11, 20
Touch-potential, unit of,	...	...	...	93
Triśrit-karaṇ (triplication )	...	...	...	172
Tuttha (green vitriol )	...	...	...	25
Tuvarī (alum-earth )	...	...	...	17

U

Uparasas	11, 20
U'rddhvapa'tana apparatus	16
Utpala	167

V

Vaikra'nta, essence of	4, 11
Vaipulya Su'tras	xxxii
Vaisheshika-Nya'ya	59
Vartaloḥa	20
Va'tsya'yana-bha'shya	210
Veda'nta	59
view of	168
Vida	10, 11
Vimala	11
Vitriol, blue,	10
green,	20
Vrihatsa'shita'	lxxxvii, 30
Vrittaloḥa	lxxxix
Vya'sa-bha'shya	59, 75

W

Weight of Air	223
---------------	-----

Y

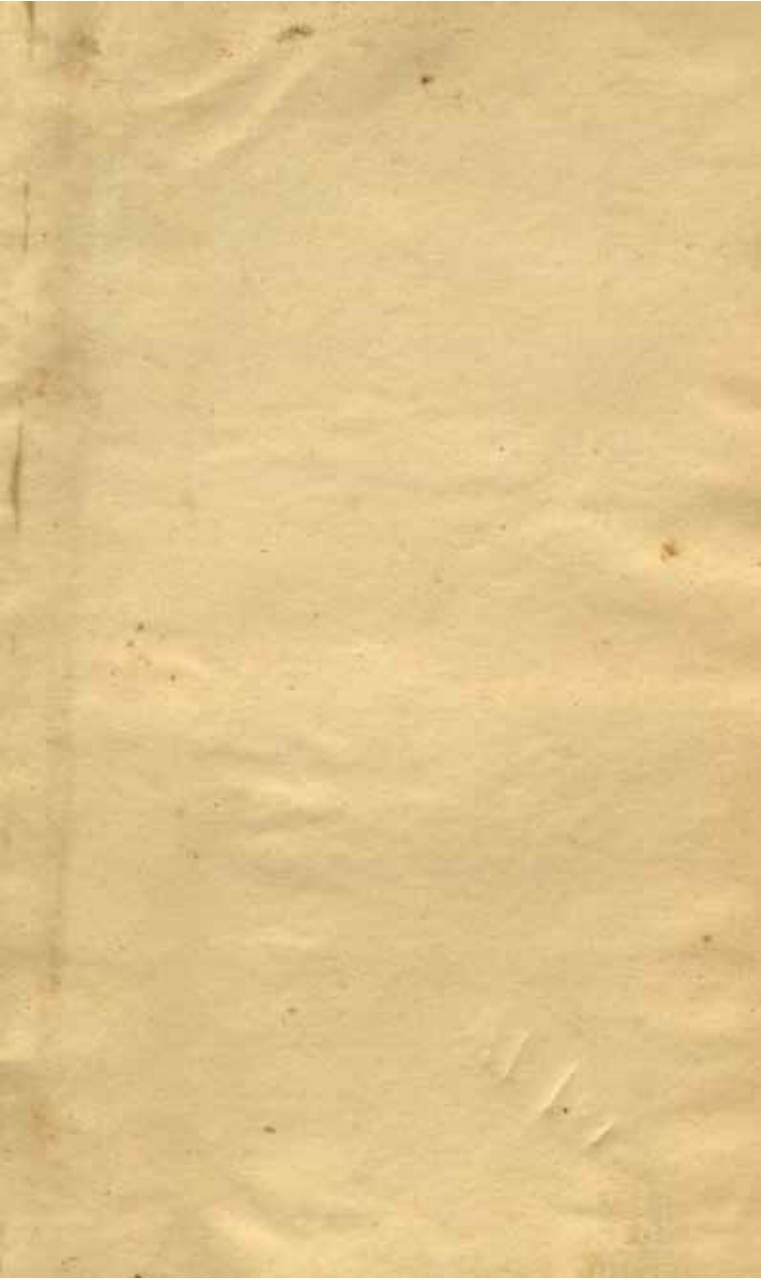
Yasada	lxxxii
Yasada'yaka	24
Yavaksha'ra	11
Yavanas	lxxxiv
Yoga'cha'ra-bhu'mi-sa'stra	xxvi
Yogaratra'kara	xcvi
Yogasudha'nidhi	xcvi

Z

Zinc	4
extraction of,	...	...	...	17, 19, 22
Zircon	...	...	..	34



(123 2nd)



see Vol T

N.C.

५

1815

Central Archaeological Library,
NEW DELHI.

8865

Call No. Sa 6 Vr / Ray.

Author—Ray, P. C.

Title—History of Hindu
Chemistry. Vol-II

Borrower No.	Date of Issue	Date of Return

"A book that is shut is but a block"

CENTRAL ARCHAEOLOGICAL LIBRARY
GOVT. OF INDIA
Department of Archaeology
NEW DELHI.

Please help us to keep the book
clean and moving.